UNCLASSIFIED

AD NUMBER

AD859288

NEW LIMITATION CHANGE

TO

Approved for public release, distribution unlimited

FROM

Distribution authorized to U.S. Gov't. agencies and their contractors; Critical Technology; APR 1969. Other requests shall be referred to Naval Air Systems Command, ATTN: AIR-6022, Washington, DC 20360.

AUTHORITY

USNASC ltr dtd 26 Oct 1971

THIS PAGE IS UNCLASSIFIED

Report No. MSD-P69-144

AD859288

Contract No. 00019-68-C-0247

COLLOCATION FLUTTER ANALYSIS STUDY

This document is subject to special export controls and transmittal to foreign governments or foreign nationals may be made only with prior approval of the Naval Air Systems Command (AIR-~~[illegible]~~). 6022

VOLUME III (Continued)

AICs - COMPUTER PROGRAM TO CALCULATE UNSTEADY AERODYNAMIC INFLUENCE COEFFICIENTS FOR SUBSONIC, TRANSONIC AND SUPERSONIC FLIGHT

APRIL 1969

MISSILE SYSTEMS DIVISION

HUGHES

HUGHES AIRCRAFT COMPANY

COFA

COLLOCATION FLUTTER ANALYSIS STUDY

VOLUME III (CONT'D)

AICs - COMPUTER PROGRAM TO CALCULATE
UNSTEADY AERODYNAMIC INFLUENCE COEFFICIENTS FOR
SUBSONIC, TRANSONIC, AND SUPERSONIC FLIGHT

Prepared by Dynamics & Environments Section Personnel
Hughes Aircraft Company, Missile Systems Division
Contract No.00019-68-C-0247

APRIL 1969

NOTICE TO USERS

Portions of this document have been judged by the Clearinghouse to be of poor reproduction quality and not fully legible. However, in an effort to make as much information as possible available to the public, the Clearinghouse sells this document with the understanding that if the user is not satisfied, the document may be returned for refund.

If you return this document, please include this notice together with the IBM order card (label) to:

Clearinghouse
Attn: 152.12
Springfield, Va. 22151

TABLE OF CONTENTS

ABSTRACT

Subsonic Kernel function, transonic box, and supersonic box methods for computing unsteady aerodynamics are applied to the problem of interaction of a general trapezoidal wing with a downstream rectangular control surface lying in the wake of the wing. The unsteady aerodynamic forces are related to a set of collocation stations through a series of matrix transformations, interpolations, and differentiations. The resulting matrix is a set of aerodynamic influence coefficients (AICs) that are directly applicable to flutter analysis.

The transformation of the unsteady aerodynamics into AICs is presented as a separate discussion; followed by discussions for the developments of analytical techniques for each flight regime. The analytical developments and a discussion of the basic single-planar-surface are presented, followed by the complete two-surface solutions for the general aerodynamic forces. Each of the three numerical methods is developed by detailing the complete set of equations necessary to compute airloads on the configurations considered. A computer program to determine the AIC matrix for each flight regime is presented with a complete discussion of usage and logical flow. Also included are program listings, flow charts and sample input and output problems.

PART V - SECTION A

TECHNICAL DISCUSSION OF THE TRANSONIC BOX METHOD

When the flight speed approaches the acoustic speed (i.e., transonic flow), the Mach number is near unity and Equation 4.1 can be rewritten

$$\phi_{yy} + \phi_{zz} = M^2 (2ik\phi_x - k^2\phi) \qquad (5.1)$$

which is valid according to Reference 6 if $k \gg |M-1|$. Using this version of the linearized flow equation leads to a similarity rule in transonic flow. Air loads for Mach numbers near unity may be computed by a transformation of the geometry and flow field to the equivalent problem at M=1. The absence of the ϕ_{xx} term because of β^2 being of small order restricts the flow to one that has no variation in local Mach number along the surface. This restriction supplements the thin airfoil assumptions previously used in linearization. The condition can be simply stated as

$$k \gg |1 - M_L|$$

where M_L is the local Mach number over the surface.

A pulsating doublet placed in the M=1 free stream with the axis parallel to the z axis is a solution to Equation 5.1 and produces a velocity potential at (x, y, z) given by

$$\phi_D = \frac{ik(z-\zeta)}{2\pi(x-\xi)^2} \exp\left\{ -1/2\, ik \left[(x-\xi) + \frac{(y-\eta)^2 + (z-\zeta)^2}{(x-\xi)} \right] \right\} \qquad (5.2)$$

where the doublet is positioned at the point (ξ,η,ζ). The doublet in transonic flow has no influence at points upstream of the line $x=\xi$. Consequently, the potential is zero in that region. The velocity potential due to a doublet is discontinuous at the point (ξ,η,ζ).

That Equation 5.2 satisfies equation 5.1 may be checked by substitution. Furthermore, a solution to 5.1 may be obtained by superposition. This solution will be represented in the form

$$\phi(x,y,z) = \iint \phi(\xi,\eta)\, \phi_D(x,y,z,\xi,\eta,o)\, d\xi d\eta \qquad (5.3)$$

and it may be further shown that in the limit as $z \rightarrow 0$

$$\left[\phi(x,y,z)_{z+} - \phi(x,y,z)_{z-}\right] = \phi(x,y)$$

A sheet of these doublets covering the wing, wake, and tail will then provide the required lifting antisymmetry and jump in potential between upper and lower sides when the doublet strength function is determined by the appropriate boundary conditions. The velocity potential required to produce the necessary vertical velocity at a point (x,y) on the wing can be determined by application of the tangential flow boundary condition

$$w_W = \iint_W \varphi(\xi,\eta)\,\psi\,(x-\xi,\ y-\eta)\,d\xi\,d\eta \qquad (5.4)$$

where

$$\psi(x-\xi,\ y-\eta) = \lim_{z\to 0} \frac{1}{z}\,\phi_D = \frac{ik}{2\pi}\,\frac{1}{(x-\xi)^2}\,\exp\left[-\frac{1}{2}\,ik\left((x-\xi) + \frac{(y-\eta)^2}{(x-\xi)}\right)\right]$$

The function ψ is in effect the limit as $z \to 0$ of $\frac{\partial \phi_D}{\partial z}$ when $\xi = 0$. It is, consequently, the doublet downwash influence function when $\xi \le x$. The zero pressure jump condition is written here for the wake velocity potential in terms of the wing trailing edge quantities

$$\phi_{Wake} = \phi_{W_{TE}}\,\exp\left[-ik\,(x - x_{W_{TE}})\right]. \qquad (5.5)$$

and further matching of the tangential flow condition gives the velocity potential required to produce downwash at a similar point on the tail as

$$w_T = \iint_{T+\text{Wake}+W} \phi(\xi,\eta)\,\psi(x-\xi,\ y-\eta)\,d\xi\,d\eta \qquad (5.6)$$

where the region of integration is over the entire doublet sheet forward of the line $\xi = x$ (see Reference 12).

Equations 5.4, 5.5 and 5.6 then constitute a system of equations whereby the potential jump may be determined.

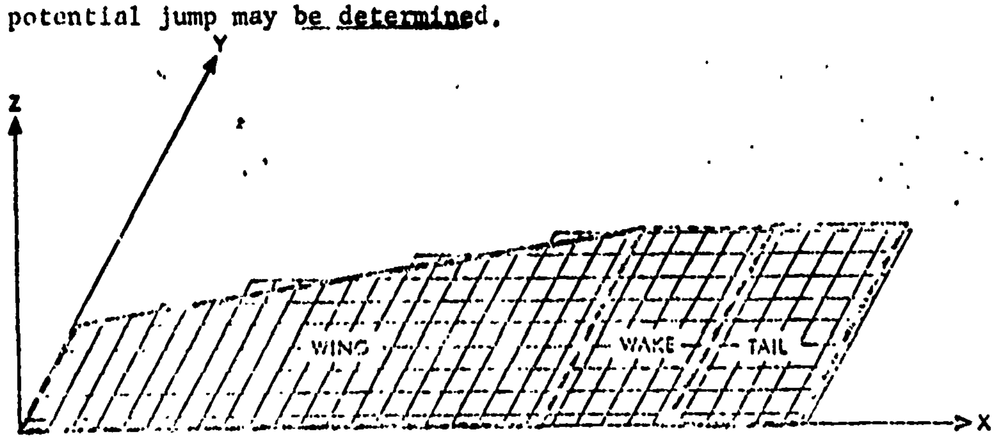


Figure 5.1 Transonic Box Overlay for a Typical Configuration at Sonic Mach Number

To compute the velocity potential distribution for each Mach number near unity and reduced frequency greater than zero, following the approach developed in Reference 1, we overlay the two surfaces and intervening wake with a system of square boxes of relative length Δ adjusted so that box centers lie along the x axis and the wing trailing edge and so that box edges lie along the y axis. A typical box overlay on a trapezoidal wing, wake, and downstream control surface is shown in Figure 5.1. Only boxes that have their centers within the respective regions are considered in this development.

If the potential function $\phi(x,y)$ is approximated by a function which is constant in each of the boxes and equal to the value at its center in the wake region, the downwash condition on the wing and control surfaces is matched at the center of each box.

The boxes will be designated by n and v in the chordwise direction and by m and μ in the spanwise direction. Then for (n, m) on the wing

$$w_{n,m} = \sum_{\nu} \sum_{\mu} \phi_{\nu,\mu} A \; (n-\nu, |m-\mu|) \tag{5.7}$$

for (n,m) on wake,

$$\phi_{n,m} = \phi_{W_{TE_m}} \exp\left[-ik\,(n-n_{W_{TE}})\right] \tag{5.8}$$

and for (n,m) on T, (ν,μ) on W, T, and wake,

$$w_{n,m} = \sum_{\nu} \sum_{\mu} \phi_{\nu,\mu} A \; (n-\nu, |m-\mu|) \tag{5.9}$$

where $n = x/\Delta$, $m = y/\Delta$, $\nu = \xi/\Delta$, and $\mu = \eta/\Delta$ are coordinates of the box centers and $\nu \leq n$. The aerodynamic influence coefficients (AIC's) are given by

$$A\,(n-\nu, |m-\mu|) = \iint\limits_{\substack{BOX\\AREA}} \psi\,(x-\xi,\; y-\eta)\; d\xi\, d\eta \tag{5.10}$$

and are computed for each pair of relative box locations by integration of the doublet influence function, ψ, over that portion of the sending box centered at (ν,μ) that influences the receiving point (n,m). Approximation formulas and integration techniques for evaluation of the transonic AIC's are developed in Reference 12.

Solutions to Equation 5.10 at each box center can be obtained most efficiently by the separation of the terms in the nth row from the remainder of the sum to

obtain the smaller system of equations for the wing, W,

$$\sum_{\mu} A(o, |m-\mu|)\phi_{n,\mu} = w_{n,m} - \sum_{\nu<n}\sum_{\mu} A(n-\nu, |m-\mu|)\phi_{\nu,\mu} \qquad (5.11)$$

where the AIC's $A(o, |m-\mu|)$ represent the effect of every other box in the nth row on the mth box, and the double summation gives the contribution to the downwash at the box center of all the boxes located in all the upstream rows. Since the downwash is directly calculable from tangential flow considerations (Equation 5.4), and since the velocity potential to be computed at the box center is contained in a sum, Equation 5.11 has to be applied to the entire nth row to solve for the velocity potentials at all box centers in that row simultaneously. The procedure would build up the velocity potential distribution over the wing one row at a time until the trailing edge row was completed. The numerical complexity is not increased, however, by a large number of box rows over the configuration because the influence coming from more than 15 rows away is negligible. Therefore, the AIC's for $n-\nu>15$ are not needed.

With the wing trailing edge velocity potential values now available, the distribution is continued downstream in the wake region for all boxes by simply employing Equation 5.8 for each box. This method adequately determines the velocity potential distribution between the wing trailing edge and tail leading edge under the assumptions that no rolling up of wing tip vortices occurs. The downwash in this region is not readily computed, but fortunately is not required in subsequent computations.

To compute the velocity potential distribution on the tail, rewrite Equation 5.9 in the smaller system of equations with the velocity potentials in the nth row segregated from the upstream influence. For (n,m) on the tail, T,

$$\sum_{\mu} A(o, |m-\mu|)\phi_{n,\mu} = w_{n,m} - \sum_{\nu<n}\sum_{\mu} A(n-\nu, |m-\mu|)\phi_{\nu,\mu} \qquad (5.12)$$

where the terms are defined as above. Here again the velocity potentials for the entire nth row on the tail are computed at once, but with the double summation now extending at most 15 rows upstream. This upstream influence includes contributions not only from the tail itself, but also from the wake and wing regions included in the fifteen rows.

PART V - SECTION B

TRANSONIC AIC COMPUTER PROGRAM DESCRIPTION

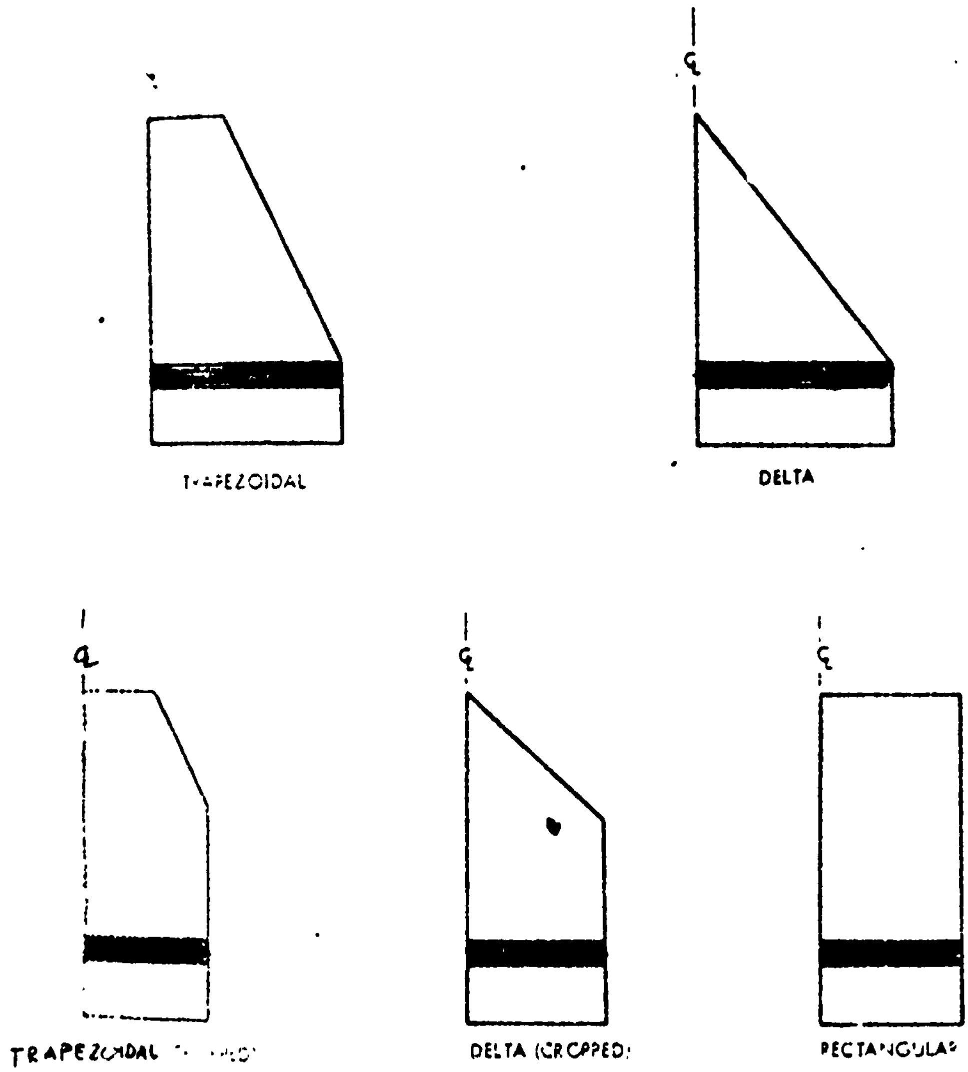
A FORTRAN IV computer program is presented which calculates transonic unsteady aerodynamic influence coefficients for a variety of single or tandem lifting surfaces. The computer solution is based on a doublet superposition approach, and a square box approximation is employed to reduce the integral equations to sums of constant values times doublet strengths at box centers times integrals dependent upon relative position, Mach number, and reduced frequency.

The various tandem configurations which can be analyzed are shown in Figure 5.2. Also it is possible to analyze a single surface (the wing). The aerodynamic surfaces are assumed to have a plane of symmetry parallel to the free stream flow. The upstream surface must have an unswept trailing edge and the rectangular trailing surface must have the same spanwise dimension as the trailing edge of the wing.

The program allows up to 40 AIC control points. The AIC stations must satisfy the following requirements:

(1) The chordwise rows must be parallel to the flow stream.
(2) The chordwise rows on a surface must have the same number of control points.
(3) The control points in each spanwise row must have the same fractional chordwise location.
(4) The origin for the AIC station coordinates and the wing and control surface coordinates must be at the leading edge root of the wing.

Examples of acceptable AIC control point patterns for the transonic program are illustrated in Figure 5.3.



Diaphragm Region

FIGURE 5.2 TANDEM COPLANAR CONFIGURATIONS AT TRANSONIC MACH NUMBERS

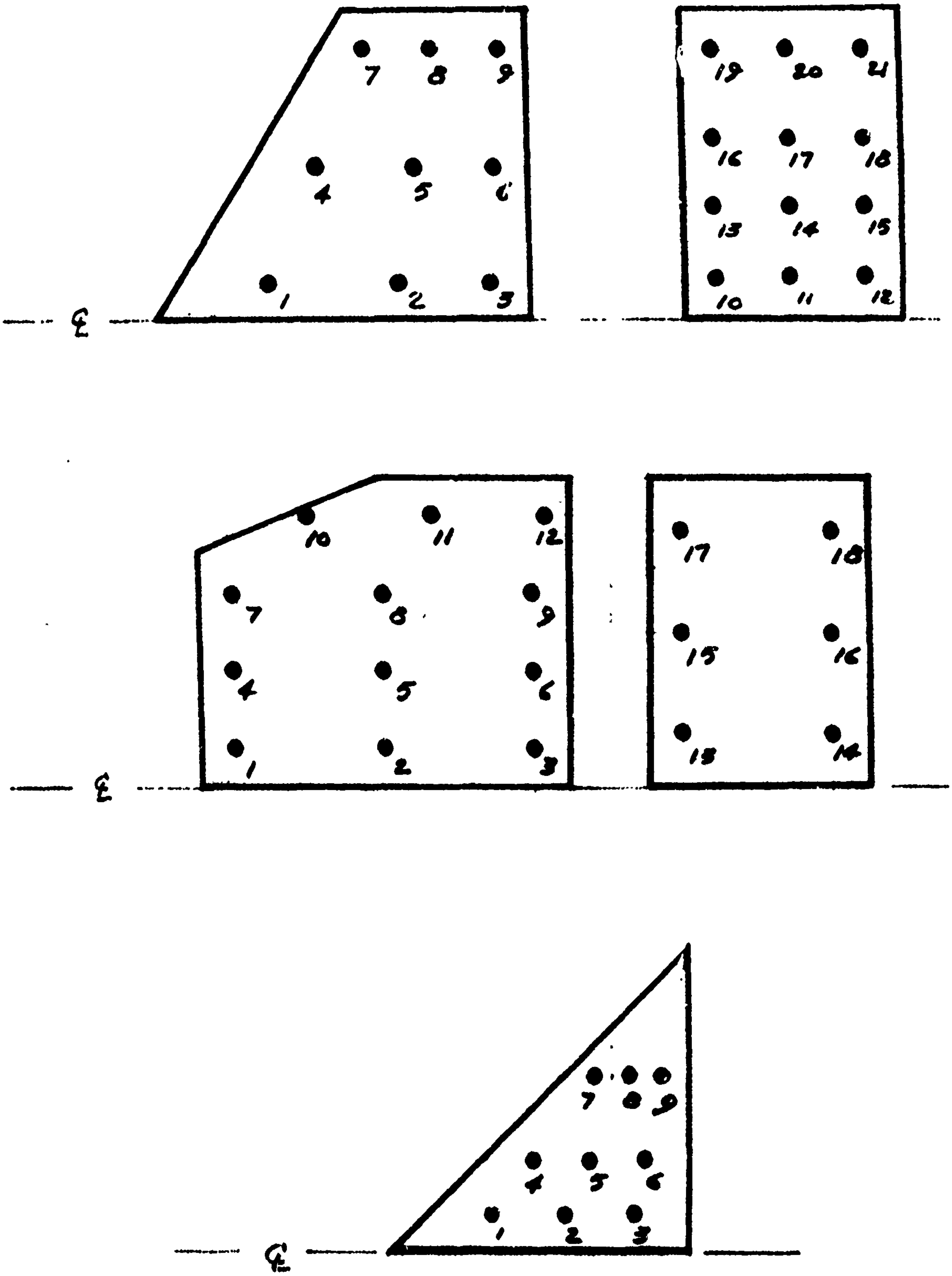


FIGURE 5.3. EXAMPLES OF ACCEPTABLE AIC CONTROL POINT PATTERNS FOR THE TRANSONIC PROGRAM

The transonic program is presently limited to 45 boxes on the aerodynamic surfaces. This limitation does not include the diaphragm boxes in the gap region. The restriction results from performing all operations on the computer in core without utilizing peripheral tape and disc units.

The user specifies the number of boxes along the wing root and the computer program determines the size of the boxes and overlay pattern which will cover the planform. The box centers of the first chordwise row will lie along the root of the surfaces. The last spanwise row of boxes on the wing will have their centers on the trailing edge. If NBW is selected by the user as the number of boxes along the wing root and if the wing root dimension is $2b_r$, then the box size will be $\Delta \times \Delta$ where $\Delta = 2b_r/(NBW - .5)$. Knowing the size of the boxes and the planform geometry, the user can estimate if the 45 box restriction is satisfied. An example of a typical box overlay is shown in Figure 5.4.

The transonic AIC computer program consists of a main program (MAIN) and 20 subroutines and function subprogram. Execution begins with MAIN calling subroutine DAIN which reads the input data. Control then passes into a Mach number loop where a test is made to determine if the Mach number satisfies the criterion $|M - 1.0| < 0.05$. Subroutine CODE is called to approximate the surface and gap regions with a sonic box overlay. The output subroutine POUT is called and the input flight conditions, geometry, and map of the sonic box overlay are printed. The AIC station locations are also printed if the option is exercised. A check is made in MAIN to determine if the number of boxes on the wing and control surface does not exceed 45.

The subroutine TRAMP is called by MAIN to generate the substantial derivative matrix [W]. The [W] matrix relates the Mach boxes on the surfaces to the AIC stations and serves as a substantital derivative operator. Subroutines called by TRAMP are CMAT, SMAT, TMAT, BMAT, RMAT, and MINV.

Control passes into the frequency loop and a test is made to determine that a non-zero frequency or reduced frequency is being considered. Subroutine POT2H is called to compute in-plane velocity potential influence coefficients for the reduced frequency. These coefficients are dependent only on the relative position of the boxes, the Mach number and reduced frequency.

The main program now passes into a loop which examines each box and for boxes on the surfaces, the subroutine PHIB is called to form the product of velocity potentials computed for boxes within the zone of influences times the appropriate velocity potential influence coefficient.

The influence of each box on the other boxes is constructed and the resulting system of simultaneous complex equations is solved by the subroutine MSIMEC to determine the velocity potential at box centers. The velocity potentials are converted to pressure through a substantial derivative operator constructed by subroutine SD2. Multiplying pressure by the box area yields the force at each box center on the surfaces. These forces are transferred to the AIC stations through static considerations thereby forming the AIC matrix. This operation is performed by subroutine FORCE. The output subroutine POUT is called to print the AIC matrix.

1.0 PROCESSING REQUIREMENTS

The input and output files used by the program are 05 and 06, respectively. All read and write statements are contained in MAIN, POUT, and DAIN. Peripheral tape and disc inputs are not used by the program. Approximately 40,000 cells of core storage is required.

A standard input form of six 12-column fields per card is used by the program. Floating point numbers (6E12.5 format) may lie anywhere within the appropriate field but fixed point numbers (6I12 format) must be right adjusted. Detailed instructions for data input are given and listings of data cards for sample problems are provided.

2.0 INPUT INSTRUCTIONS

Instructions for preparing input data for the transonic AIC computer program are presented here. The field location and format for each quantity is specified. Any set of units may be used for geometric dimensions and acoustic velocity as long as they are consistent, e.g., if inches is used for length, then the acoustic velocity must have dimensions of inches per second. The required data and the sequence in which the information is entered is as follows:

1. Streamwise Coordinates (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	X(1)	X(2)	X(3)	X(4)	X(5)	
Item	(1)	(2)	(3)	(4)	(5)	

(1) X(1) Wing root leading edge coordinate
(2) X(2) Wing tip leading edge coordinate
(3) X(3) Wing trailing edge coordinate
(4) X(4) Control surface leading edge coordinate
(5) X(5) Control surface trailing edge coordinate

A single surface, the wing, may be analyzed by setting X(4) and X(5) equal to X(3). The various configurations are generated as shown in Table 5.1 . The origin for the planform and AIC station coordinates must be at the leading edge root of the wing, therefore X(1) and Y(1), described below, must always be zero.

2. Spanwise Coordinates and Acoustic Velocity (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	Y(1)	Y(2)	Y(3)	SOUND		
Item	(1)	(2)	(3)	(4)		

(1) Y(1) Wing root spanwise coordinate
(2) Y(2) Wing leading edge spanwise coordinate
(3) Y(3) Wing (and control surface) tip spanwise coordinate
(4) SOUND Speed of sound at altitude for which analysis is performed

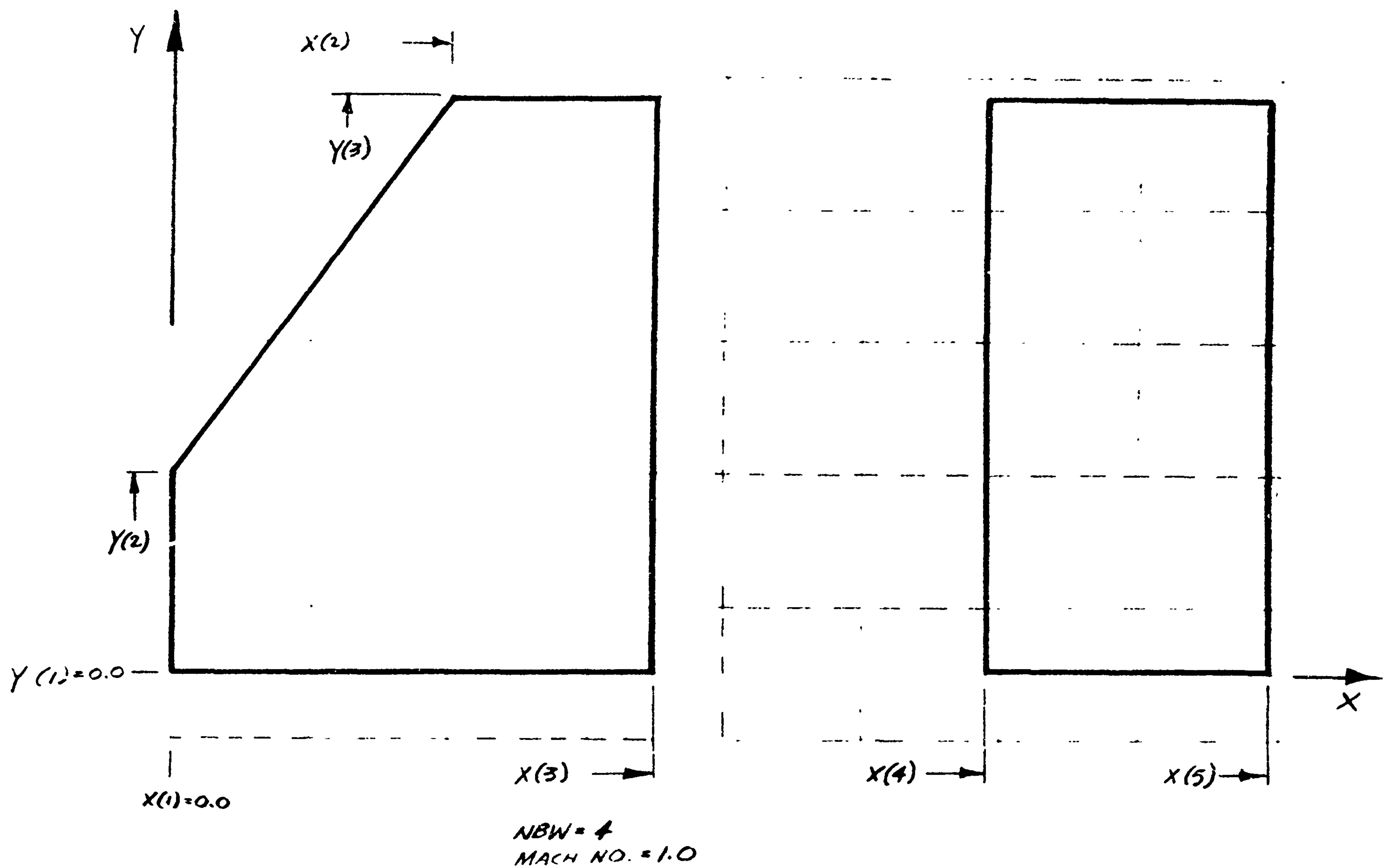


FIGURE 5.4 GEOMETRIC DESCRIPTION AND SONIC BOX OVERLAY

TABLE 5.1 OPTIONAL CONFIGURATIONS

CONFIGURATION	CHORDWISE COORDINATE	SPANWISE COORDINATE
	X(1) = 0.0	Y(1) = 0.0
	X(2) = 0.0	Y(2) = 0.0
RECTANGULAR	X(3) > 0.0	Y(3) > 0.0
	X(4) ≥ X(3)	
	X(5) ≥ X(4)	
	X(1) = 0.0	Y(1) = 0.0
	X(2) > 0.0	Y(2) = 0.0
	X(3) = X)2)	Y(3) > 0.0
DELTA	X(4) ≥ X(3)	
	X(5) ≥ X(4)	
	X(1) = 0.0	Y(1) = 0.0
	X(2) > 0.0	Y(2) > 0.0
TRAPEZOIDAL	X(3) = X(2)	Y(3) > Y(2)
	X(4) ≥ X(3)	
	X(5) ≥ X(4)	
	X(1) = 0.0	Y(1) = 0.0
	X(2) > X(1)	Y(2) > 0.0
TRAPEZOIDAL (CROPPED)	X(3) > X(2)	Y(3) > Y(2)
	X(4) ≥ X(3)	
	X(5) ≥ X(4)	
	X(1) = 0.0	Y(1) = 0.0
	X(2) > 0.0	Y(2) = 0.0
DELTA (CROPPED)	X(3) > X(2)	Y(3) > Y(2)
	X(4) ≥ X(3)	
	X(5) ≥ X(4)	

3. General Information (6I12 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	NMACH	KF	NFREQ	NBW	LPUNCH	
Item	(1)	(2)	(3)	(4)	(5)	

(1) NMACH Number of Mach numbers (Maximum 6)

(2) KF Option to input frequencies or reduced frequencies:

KF = 0 frequencies

KF = 1 reduced frequencies

(3) NFREQ Number of frequencies or reduced frequencies at each Mach number (maximum 10)

(4) NBW Number of chordwise boxes on wing

(5) LPUNCH Option to punch AICs on cards:

LPUNCH = 0 no punched output

LPUNCH = 1 punch AICs for wing only

LPUNCH = 2 punch AICs for control surface only

LPUNCH = 3 punch individual AIC matrix for wing and control surface

LPUNCH = 4 punch total AIC matrix for wing-control surface combination

The AIC matrices are punched by rows with a 1P6E12.5 format. Each row of an AIC matrix begins on a new card.

4. Mach Numbers (6E12.5 format)

Column	1-12	13-24	24-36	37-48	49-60	61-72
Name	FMACH(1)	FMACH(2)	FMACH93)	FMACH(4)	FMACH(5)	FMACH(6)
Item	(1)	(2)	(3)	(4)	(5)	(6)

(1) FMACH (1) Mach number

(2) FMACH (2) Mach number

. . . .

. . . .

. . . .

(NMACH) FMACH (NMACH) Mach number

Enter NMACH values of Mach number (see Part 3, Item 1). Mach numbers must be in the range 0.95 to 1.05.

5. Frequencies (or Reduced Frequencies) (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	FREQ(1)	FREQ(2)	FREQ(3)	FREQ(4)	FREQ(5)	FREQ(6)
Item	(1)	(2)	(3)	(4)	(5)	(6)

Input NFREQ values of frequency or reduced frequency (see Part 3, Items 2 and 3). Reduced frequency is defines as $k_r = \frac{\omega\ b_r}{U}$ where b_r is the semi-chord of the wing root, U is the free stream velocity and ω is the oscillatory angular frequency in radians/sec

(1) FREQ (1) frequency (CPS) or k_r

(2) FREQ (2) frequency (CPS) or k_r

. . . . .

. . . . .

. . . . .

. . . . .

(NFREQ) FREQ (NFREQ) frequency (CPS) or k_r

If NFREQ >6, continue input of FREQ (7) to FREQ (NFREQ) on new card.

6. Number of AIC Stations (6I12 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	NXWING	NYWING	NXCS	NYCS		
Item	(1)	(2)	(3)	(4)		

(1) NXWING — Number of chordwise AIC collocation stations on wing

(2) NYWING — Number of spanwise AIC collocation stations on wing

(3) NXCS — Number of chordwise AIC collocation stations on control surface. Set equal to zero if analysis is for wing only

(4) NYCS — Number of spanwise AIC collocation stations on control surface. Set equal to zero if analysis is for wing only.

7. Spanwise Location of AIC Stations on Wing (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	YAIC(1,W)	YAIC(2,W)	YAIC(3,W)	YAIC(4,W)	YAIC(5,W)	YAIC(6,W)
Item	(1)	(2)	(3)	(4)	(5)	(6)

(1) YAIC(1,W) — Spanwise coordinate of first row of AIC collocation stations on wing

(2) YAIC(2,W) — Spanwise coordinate of second row of AIC collocation stations on wing

. . .

(NYWING) YAIC(NYWING, W) — Spanwise coordinate of last row of AIC collocation stations on wing

AIC station rows are numbered from root to tip of surface. If NYWING > 6, continue input on new card(s).

8. Spanwise Location of AIC Stations on Control Surface (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	YAIC(1,CS)	YAIC(2,CS)	YAIC(3,CS)	YAIC(4,CS)	YAIC(5,CS)	YAIC(6,CS)
Item	(1)	(2)	(3)	(4)	(5)	(6)

(1) YAIC(1,CS) Spanwise coordinate of first row of AIC collocation stations on control surface

(2) YAIC(2,CS) Spanwise coordinate of second row of AIC collocation stations on control surface

. . .

. . .

. . .

(NYCS) YAIC(NYCS,CS) Spanwise coordinate of last row of AIC collocation stations on control surface

Omit this input if only the wing is analyzed. For NYCS 6, continue input on new card(s). AIC station rows are numbered from root to tip of surface.

9. Chordwise Location of AIC Stations on Wing (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	XAIC(W,1,1)	XAIC(W,1,2)	XAIC(W,1,3)	...	...	...
Item	(1)	(2)	(3)	(4)	(5)	(6)

(1) XAIC(W,1,1) Streamwise coordinate of first AIC collocation station in first row on wing

(2) XAIC(W,1,2) Streamwise coordinate of second AIC collocation station in first row on wing

. . .

. . .

. . .

(NXWING*NYWING) XAIC (W, NYWING, NXWING) Streamwise coordinate of last AIC collocation station in last row on wing

9. continued

Streamwise numbering sequence is from leading edge to trailing edge (see Figure 5.3). Continue input of values for each row immediately after the last value of the preceeding row; do not begin input of each row on new card.

10. Chordwise Location of AIC Stations on Control Surface (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	XAIC(CS,1,1)	XAIC(CS,1,2)	XAIC(CS,1,3)	...	...	...
Item	(1)	(2)	(3)	(4)	(5)	(6)

Procedure to input streamwise coordinate location of AIC stations on control surface is the same as wing above. Omit this input if only wing is analyzed.

3.0 SAMPLE PROBLEMS

The operation of the transonic AIC program is demonstrated with three sample problems. A trapezoidal wing-rectangular control surface combination, a cropped trapezoidal and a delta configuration are analyzed. Explanation of input parameters and complete listings of input cards and computer output are given for each sample problem.

Sample Problem 1.

Transonic AIC's are obtained for a trapezoidal wing and rectangular control surface. The planform geometry and AIC stations are shown in Figure 5.5. The dimensional unit used for length is feet, therefore the acoustic velocity is entered as feet/sec. Five boxes were specified for NBW. The box overlay, which is included with the output, has 21 boxes on the wing and 10 on the control surface, thereby satisfying the 45 box limitation. There are 10 diaphragm boxes in the gap area. The analysis is performed for M = 1.0, k_r = 0.10 and a = 1116.87 ft/sec (sea level). Input parameters are summarized below and a listing of the input data cards and computer output follows.

X(1) = 0.0'	X(2) = 1.0'	X(3) = 2.0'	X(4) = 3.0'	X(5) = 4.0'
Y(1) = 0.0'	Y(2) = 0.0'	Y(3) = 2.0'		

SOUND = 116.87 ft/sec	acoustic velocity (sea level)
NMACH = 1	number of Mach numbers
KF = 1	input reduced frequency
NFREQ = 1	number of reduced frequencies
NBW = 5	number of chordwise boxes on wing
LPUNCH = 4	punch combined wing-control surface AIC matrix on cards
FMACH (1) = 1.0	Mach number
FREQ (1) = 0.10	reduced frequency
NXWING = 3	number of chordwise AIC stations on wing
NYWING = 5	number of spanwise AIC stations on wing
NXCS = 2	number of chordwise AIC stations on control surface
NYCS = 3	number of spanwise AIC stations on control surface

YAIC(1,W) = 0.2'	YAIC(2,W) = 0.6'	YAIC(3,W) = 1.0'
YAIC(4,W) = 1.4'	YAIC(5,W) = 1.8'	

YAIC(1,CS) = 0.4'	YAIC(2,CS) = 1.0'	YAIC(3,CS) = 1.6'

XAIC(1,1,W) = 0.575'	XAIC(1,2,W) = 1.050'	XAIC(1,3,W) = 1.525'
XAIC(2,1,W) = 0.725'	XAIC(2,2,W) = 1.150'	XAIC(2,3,W) = 1.575'
XAIC(3,1,W) = 0.875'	XAIC(3,2,W) = 1.250'	XAIC(3,3,W) = 1.625'
XAIC(4,1,W) = 1.025'	XAIC(4,2,W) = 1.350'	XAIC(4,3,W) = 1.675'
XAIC(5,1,W) = 1.175'	XAIC(5,2,W) = 1.450'	XAIC(5,3,W) = 1.725'

XAIC(1,1,CS) = 3.25'	XAIC(1,2,CS) = 3.75'
XAIC(2,1,CS) = 3.25'	XAIC(2,2,CS) = 3.75'
XAIC(3,1,CS) = 3.25'	XAIC(3,2,CS) = 3.75'

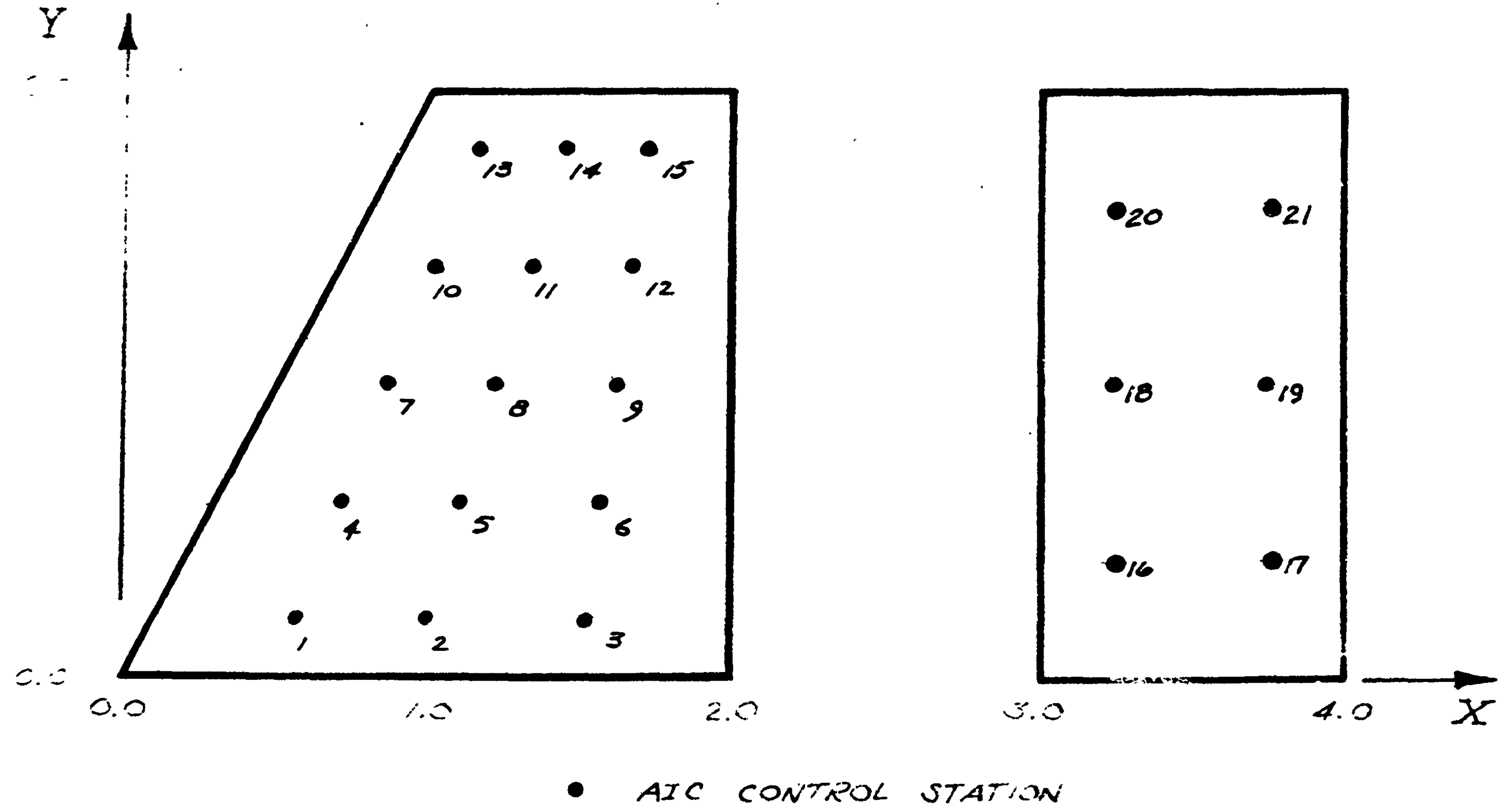


FIGURE 5.5. TRANSONIC SAMPLE PROBLEM 1.

```
                                  DATA CARD COLUMN NUMBER
********************************************************************************
         1111111111222222222233333333334444444444555555555566666666667777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
********************************************************************************

0.0       1.0       2.0       3.0       4.0
0.0       0.0       2.0       1116.87
         1         1         1         5         4
1.0                                                           MACH NO.
0.1                                                           RED FREQ
         3         2         2         3
0.2       0.6       1.0       1.4       1.8                   Y-WING
0.4       1.0       1.6                                       Y-TAIL
0.575     1.050     1.525     0.725     1.150     1.575       X-WING
0.875     1.250     1.625     1.025     1.350     1.675       X-WING
1.175     1.450     1.725                                     X-WING
3.25      3.75      3.25      3.75      3.25      3.75        X-TAIL

********************************************************************************
         1111111111222222222233333333334444444444555555555566666666667777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
********************************************************************************
                                  DATA CARD COLUMN NUMBER
```

FIGURE 5.6. LISTING OF INPUT DATA CARDS FOR TRANSONIC SAMPLE PROBLEM 1.

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM

FLIGHT CONDITIONS AND GEOMETRY

MACH NUMBER = 1.00000 SPEED OF SOUND = 1116.870 L/T RHO= 1.00

	WING	TAIL
L.E. STATION (L)	0.	3.000
ROOT CHORD (L)	2.000	1.000
L.E. SPAN (L)	0.	2.000
T.E. SPAN (L)	2.000	2.000
TIP CHORD (L)	1.000	1.000
TOTAL AREA (L*L)	6.000	4.000
CHORDWISE BOXES	5	2
SPANWISE BOXES	5	5

TOTAL CHORDWISE BOXES = 9 BOX CHORD = 4.44444E-01 L BOX SPAN = 4.44444E-01 L

HUGHES AIRCRAFT CO, TRANSONIC AIC PROGRAM (CONT-D)

```
MAP OF SONIC BOX OVERLAY      SS
ON WING, TAIL AND WAKE        SSSS
        (S) - WING            SSSSS
        ($) - TAIL            SSSSS
        (.) - WAKE            SSSSS
                              .....
                              .....
                              $$$$$
                              $$$$$
```

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT-D)

AIC COLLOCATION STATION COORDINATES ON THE WING

YAIC	XAIC VALUES--		
0.200000E 00	0.575000E 00	0.105000E 01	0.152500E 01
0.600000E 00	0.725000E 00	0.115000E 01	0.157500E 01
0.100000E 01	0.875000E 00	0.125000E 01	0.162500E 01
0.140000E 01	0.102500E 01	0.135000E 01	0.167500E 01
0.180000E 01	0.117500E 01	0.145000E 01	0.172500E 01

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT-D)

AIC COLLOCATION STATION COORDINATES ON THE TAIL

YAIC	XAIC VALUES--	
0.400000E 00	0.325000E 01	0.375000E 01
0.100000E 01	0.325000E 01	0.375000E 01
0.160000E 01	0.325000E 01	0.375000E 01

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT-D)

OSCILLATORY FREQUENCY (CPS) 1.77755E 01

REFERENCE CHORD 1.00000E 00

REDUCED FREQUENCY (REF. CHORD) 1.00000E-01

REDUCED VELOCITY (REF. CHORD) 1.00000E 01

FREE STREAM MACH NUMBER 1.00000E 00

FREE STREAM VELOCITY 1.11687E 03

DENSITY 1.00

DYNAMIC PRESSURE (1/2*RHO*VEL**2) 6.23699E 05

AERODYNAMIC INFLUENCE COEFFICIENTS

RL	IM	RL	IM	RL	IM	RL	IM	RL	IM
ROW = 1									
1.2128E 02	-3.8899E 01	-1.3410E 02	4.2813E 01	1.1546E 01	-9.3091E 00	-3.4286E 01	1.9477E 01	4.5883E 01	-3.0013E 01
-1.1299E 01	1.1797E 01	4.8711E 02	-2.5678E 02	-7.7229E 02	3.9792E 02	2.8159E 02	-1.4958E 02	-1.5659E 02	5.8982E 01
2.3520E 02	-7.8906E 01	-7.7316E 01	2.3319E 01	4.6931E 01	-4.0889E 00	-7.6954E 01	8.7285E 00	2.9945E 01	-5.5110E 00
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.								
ROW = 2									
-5.1919E 01	2.8983E 01	1.1778E 02	-5.3567E 01	-6.5761E 01	2.3969E 01	3.7301E 00	-4.4509E 00	-1.0191E 01	8.1207E 00
6.4329E 00	-3.5520E 00	-6.4991E 00	7.4964E 01	5.2879E 01	-1.4999E 02	-4.6382E 01	7.3568E 01	3.0293E 01	-3.9964E 01
-6.4973E 01	6.8227E 01	3.4346E 01	-2.8032E 01	5.2388E 01	-6.6442E 01	-8.1245E 01	9.9841E 01	2.7992E 01	-3.4178E 01
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.								
ROW = 3									
-1.1478E 02	3.8595E 01	2.4457E 02	-5.7294E 01	-1.2908E 02	1.8067E 01	1.3285E 01	5.8199E 00	-2.9218E 01	8.3588E 00
1.5802E 01	-2.4229E 00	-1.4150E 02	1.2562E 02	3.2139E 02	-2.1599E 02	-1.7570E 02	[illegible].9047E 01	5.3284E 01	-3.3027E 00
-1.0833E 02	6.3011E-01	5.4860E 01	2.8433E 00	7.0953E 00	9.4441E 01	1.77[illegible]E 01	-1.7054E 02	-2.4259E 01	7.5237E 01
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.								
ROW = 4									
7.365[illegible]E 01	-2.1286E 01	-7.9182E 01	1.7757E 01	4.5807E 00	1.8067E-01	-1.2547E 01	1.4933E 01	2.7140E 01	-2.3513E 01
-1.432[illegible]E 01	8.5637E 00	3.3510E 02	-1.5121E 02	-5.0648E 02	2.2227E 02	1.6890E 02	-7.7736E 01	-4.5482E 01	2.7560E 01
1.3019E 02	-3.1862E 01	-3.3972E 01	6.9461E 00	5.2280E 01	-1.9198E 01	-8.0113E 01	2.9246E 01	2.7587E 01	-1.1073E 01
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.								
ROW = 5									
-7.2609E 01	2.6439E 01	8.4276E 01	-4.7584E 01	-4.5497E 01	2.0863E 01	-1.0135E 01	-3.7024E 00	1.7538E 01	7.5907E 00
-7.[illegible]158E 00	-3.7734E 00	-8.2281E 01	6.4461E 01	1.8648E 02	-1.5681E 02	-1.0365E 02	7.1609E 01	5.2475E 01	-3.3493E 01
-1.[illegible]323E 02	5.4544E 01	5.0399E 01	-2.1080E 01	2.7762E 01	-3.7037E 01	-3.4514E 01	5.2521E 01	6.1981E 00	-1.6132E 01
0.	0.	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.								

```
ROW = 6
 -7.2190E 01  2.5877E 01  1.5418E 02 -3.8275E 01 -8.1494E 01  1.1992E 01 -6.4250E 00 -3.7299E 00  1.1567E 01  6.8347E 00
 -5.1906E 00 -3.0514E 00 -1.8006E 02  8.4292E 01  3.8531E 02 -1.3665E 02 -2.0425E 02  5.1503E 01  5.9870E 01  5.3195E 00
 -1.2143E 02 -1.2098E 01  6.1369E 01  8.9079E 00 -3.4439E 01  7.7505E 01  8.9151E 01 -1.3609E 02 -5.4172E 01  5.8049E 01
  0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
  0.          0.

ROW = 7
 -1.8859E 01  2.3843E 01  5.3949E 01 -4.6908E 01 -3.5081E 01  2.2333E 01  1.1622E 01 -5.1668E 00 -2.6339E 01  9.4622E 00
  1.4700E 01 -4.1576E 00 -1.1105E 02  7.9261E 01  2.6701E 02 -1.5167E 02 -1.5583E 02  7.0748E 01  6.0415E 01 -3.1014E 01
 -1.2357E 02  5.1695E 01  6.2894E 01 -2.0471E 01  4.0997E 01 -2.9354E 01 -4.7209E 01  3.8246E 01  5.6918E 00 -9.9596E 00
  0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
  0.          0.

ROW = 8
 -2.4696E 01  1.2548E 01  5.4599E 01 -2.1031E 01 -2.9758E 01  8.2635E 00  9.6244E 00 -2.3915E 00 -2.0198E 01  3.6626E 00
  1.0540E 01 -1.2309E 00 -1.1382E 02  4.2435E 01  2.4173E 02 -7.1149E 01 -1.2754E 02  2.8227E 01  3.4525E 01 -6.1095E 00
 -6.9782E 01  7.6688E 00  3.5124E 01 -1.5007E 00 -1.9936E 01 [illegible]E 01  5.1102E 01 -2.8764E 01 -3.1120E 01  1.3237E 01
  0.          0.          0.          0.          0.                      0.          0.          0.          0.
  0.          0.

ROW = 9
 -5.4314E 01  1.0593E 01  1.1139E 02 -1.2962E 01 -5.6801E 01  2.3107E 00  1.8370E 01 -1.2727E 00 -3.7192E 01  5.0285E-01
  1.8763E 01  7.8671E-01 -2.3510E 02  3.3348E 01  4.7732E 02 -4.0386E 01 -2.4153E 02  6.8311E 00  5.2674E 01  2.7724E 00
 -1.0568E 02 -1.1425E 01  5.2838E 01  8.6764E 00 -8.4432E 01  2.9760E 01  1.7448E 02 -4.8677E 01 -8.9792E 01  1.8780E 01
  0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
  0.          0.

ROW =10
 -8.9328E 00  2.0579E 01  3.6195E 01 -4.2341E 01 -2.7322E 01  2.0922E 01  4.6229E 00 -3.5919E 00 -1.2637E 01  7.0787E 00
  8.0170E 00 -3.3313E 00 -3.8080E 01  6.0558E 01  1.2625E 02 -1.2260E 02 -8.8257E 01  6.0146E 01 -3.6096E 01 -1.3026E 01
  7.1893E 01  2.4974E 01 -3.5854E 01 -1.1773E 01  6.5899E 01 -1.9408E 01 -8.4768E 01  2.1026E 01  1.8440E 01 -3.0266E 00
  0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
  0.          0.

ROW =11
 -1.4234E 01  7.2227E 00  3.1209E 01 -1.1878E 01 -1.6881E 01  4.5424E 00  3.8107E 00 -1.2380E 00 -8.1068E 00  1.9303E 00
  4.2776E 00 -6.7195E-01 -5.2635E 01  2.3651E 01  1.1259E 02 -3.9872E 01 -5.9736E 01  1.5972E 01 -1.7715E 01 -1.2582E 00
  3.5187E 01  2.7100E 00 -1.7499E 01 -1.4244E 00 -2.4284E 01  1.2847E 01  5.4730E 01 -2.2917E 01 -3.0378E 01  9.8995E 00
  0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
  0.          0.

ROW =12
 -3.2628E 01  7.9547E 00  6.7180E 01 -1.0721E 01 -3.4373E 01  2.6989E 00  8.2003E 00 -1.1788E 00 -1.6717E 01  1.2974E 00
  8.4826E 00 -1.0692E-01 -1.1965E 02  2.6290E 01  2.4426E 02 -3.7737E 01 -1.2420E 02  1.1305E 01 -3.3947E 01 -2.0561E 00
  6.7602E 01  4.9954E 00 -3.3687E 01 -2.9217E 00 -7.1962E 01  2.0501E 01  1.4772E 02 -3.3040E 01 -7.5579E 01  1.2448E 01
  0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
  0.          0.

ROW =13
 -1.1542E 01  1.0860E 01  2.6863E 01 -1.8768E 01 -1.5201E 01  7.7533E 00  2.0281E 00 -1.8392E 00 -4.7147E 00  4.1403E 00
  2.6697E 00 -1.2731E 00 -3.4483E 01  3.4981E 01  7.9023E 01 -6.2110E 01 -4.4280E 01  2.6789E 01 -1.2892E 01 -4.3978E 00
  2.5291E 01  2.3348E 00 -1.2448E 01 -8.9493E-01 -7.7806E 01  2.5125E 01  1.6369E 02 -4.3888E 01 -8.5793E 01  1.8544E 01
  0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
  0.          0.

ROW =14
 -9.7113E 00  4.3832E 00  2.0694E 01 -6.9289E 00 -1.0915E 01  2.4964E 00  1.7446E 00 -7.2361E-01 -3.7079E 00  1.1201E 00
  1.9511E 00 -3.8773E-01 -3.0429E 01  1.4385E 01  6.4198E 01 -2.3892E 01 -3.3622E 01  9.4004E 00 -8.5060E 00 -7.1977E-01
  1.6838E 01  1.3806E 00 -8.3529E 00 -6.4769E-01 -5.7309E 01  9.5170E 00  1.1725E 02 -1.4433E 01 -5.9894E 01  4.8477E 00
  0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
```

```
 0.          0.

ROW =15
 -1.5969E 01  4.3294E 00  3.2906E 01 -6.0433E 00 -1.6846E 01  1.6806E 00  2.8943E 00 -6.8906E-01 -5.9461E 00  9.1897E-01
  3.0357E 00 -2.2424E-01 -5.0882E 01  1.4514E 01  1.0424E 02 -2.2095E 01 -5.3163E 01  7.5113E 00 -1.2676E 01 -9.3965E-01
  2.5199E 01  1.9814E 00 -1.2545E 01 -1.0330E 00 -5.9675E 01  8.4918E 00  1.8121E 02 -9.9118E 00 -9.1402E 01  1.3757E 00
  0.          0.          0.          0.          0.          0.          0.          0.          0.          0.
  0.          0.

ROW =16
  7.0249E 01 -3.8388E 01 -1.9830E 02  9.3515E 01  1.2896E 02 -5.2393E 01 -2.9616E 00  4.0124E 00  9.4689E 00 -9.7886E 00
 -6.6110E 00  5.5236E 00  8.9737E 01 -8.2926E 01 -2.6983E 02  2.0049E 02  1.8153E 02 -1.1407E 02  3.0345E 01  1.4499E 01
  8.3794E 01 -3.5054E 01 -5.3804E 01  1.9502E 01  2.2423E 01 -3.4946E 01 -7.6101E 01  8.5997E 01  5.4196E 01 -5.0030E 01
  9.5821E 01 -1.4562E-01 -9.6016E 01 -4.5234E 00 -2.1785E 00 -2.3872E 00  2.0873E 00  2.5089E 00  3.6417E 01 -4.1735E 00
 -3.6658E 01  2.4183E 00

ROW =17
  8.2945E 01 -4.1507E 01 -2.3352E 02  9.9984E 01  1.5151E 02 -5.5273E 01 -3.5944E 00  4.5264E 00  1.1357E 01 -1.0951E 01
 -7.8816E 00  6.1276E 00  1.0735E 02 -9.2294E 01 -3.2075E 02  2.2096E 02  2.1492E 02 -1.2456E 02 -3.5744E 01  1.5518E 01
  9.8493E 01 -3.7084E 01 -6.3117E 01  2.0333E 01  2.7409E 01 -3.9568E 01 -9.1666E 01  9.6453E 01  6.4816E 01 -5.5704E 01
  1.1139E 02  3.8351E 00 -1.1142E 02 -9.2712E 00 -2.4445E 00 -2.8707E 00  2.3331E 00  3.0089E 00  4.2488E 01 -3.3337E 00
 -4.2695E 01  1.2839E 00

ROW =18
  2.7990E 01 -2.5225E 01 -8.3062E 01  6.1137E 01  5.5620E 01 -3.4657E 01 -9.1882E 00  4.1301E 00  2.5706E 01 -1.0330E 01
 -1.6626E 01  5.8851E 00  1.0240E 02 -6.7477E 01 -2.9658E 02  1.6492E 02  1.9545E 02 -9.3934E 01 -2.8588E 01  1.1803E 01
  7.8479E 01 -2.8722E 01 -5.0219E 01  1.5919E 01  2.8309E 01 -2.7768E 01 -8.7886E 01  6.9020E 01  6.0022E 01 -4.0239E 01
  4.6925E 01 -4.1271E 00 -4.7184E 01  1.8646E 00  2.1083E 01  1.4830E 00 -2.1066E 01 -2.5235E 00  2.9943E 01 -2.9912E 00
 -3.0126E 01  1.5413E 00

ROW =19
  3.3455E 01 -2.8052E 01 -9.8706E 01  6.7360E 01  6.5835E 01 -3.7832E 01 -1.0812E 01  4.3960E 00  3.0198E 01 -1.0882E 01
 -1.9498E 01  6.1164E 00  1.2138E 02 -7.3842E 01 -3.5028E 02  1.7855E 02  2.3022E 02 -1.0060E 02 -3.3575E 01  1.2467E 01
  9.2077E 01 -2.9963E 01 -5.6817E 01  1.6325E 01  3.3931E 01 -3.0973E 01 -1.0462E 02  7.6261E 01  7.1165E 01 -4.4097E 01
  5.4700E 01 -2.8431E 00 -5.4906E 01  2.0283E-01  2.4454E 01  2.6096E 00 -2.4390E 01 -3.8190E 00  3.4919E 01 -2.2242E 00
 -3.5071E 01  9.3360E-01

ROW =20
  1.6014E 01 -2.0091E 01 -5.0055E 01  4.8846E 01  3.4475E 01 -2.7924E 01 -3.6424E 00  2.8403E 00  1.0745E 01 -7.0930E 00
 -7.1760E 00  4.0951E 00  4.4500E 01 -5.0033E 01 -1.3903E 02  1.2221E 02  9.5427E 01 -7.0276E 01  1.0879E 01  4.6350E 00
 -2.6961E 01 -1.0383E 01  1.5968E 01  5.7509E 00  4.4848E 01 -2.6380E 01 -1.3016E 02  6.6657E 01  8.5793E 01 -3.9089E 01
  3.3239E 01 -4.8297E 00 -3.3501E 01  3.2328E 00  5.3395E 00 -6.4594E-01 -5.3770E 00  3.8710E-01  4.4192E 01 -7.3761E-03
 -4.4286E 01 -2.1619E 00

ROW =21
  1.0371E 01 -2.2609E 01 -5.9968E 01  5.4513E 01  4.1067E 01 -3.0923E 01 -4.3351E 00  3.1376E 00  1.2734E 01 -7.7673E 00
 -8.4782E 00  4.4441E 00  5.5595E 01 -5.6093E 01 -1.6602E 02  1.3576E 02  1.1339E 02 -7.7429E 01  1.2413E 01  5.8425E 00
 -3.0811E 01 -1.3207E 01  1.8266E 01  7.3632E 00  5.3031E 01 -2.8656E 01 -1.5349E 02  7.1710E 01  1.0092E 02 -4.1659E 01
  3.5818E 01 -4.2300E 00 -3.9056E 01  2.3636E 00  6.2314E 00 -5.2750E-01 -6.2641E 00  2.2513E-01  5.1375E 01  1.8464E 00
 -5.1393E 01 -4.3724E 00
```

Sample Problem 2.

A cropped trapezoidal wing is analyzed for M = 1.0, k_r = 0.10 and '16.87 ft/sec (sea level). The trailing surface is removed from the analysis by setting X(5) = X(4) = X(3). The wing geometry and AIC stations are shown in Figure 5.7. Six chordwise boxes were specified for the wing. The resulting box overlay has 33 boxes. Input information is summarized below and a listing of the data input cards and computer output follows.

X(1) = 0.0'	X(2) = 1.0'	X(3) = 2.0'	X(4) = 2.0'	X(5) = 2.0'
Y(1) = 0.0'	Y(2) = 1.0'	Y(3) = 2.0'		

SOUND = 116.87 ft/sec	acoustic velocity (sea level)
NMACH = 1	number of Mach numbers
FK = 1	input reduced frequency
NFREQ = 1	number of reduced frequencies
NBW = 6	number of chordwise boxes on wing
LPUNCH = 1	punch wing AIC matrix on cards
FMACH (1) = 1.0	reduced frequency
NXWING = 4	number of chordwise AIC stations on wing
NYWING = 4	number of spanwise AIC stations on wing
NXCS = 0	number of chordwise AIC stations on control surface
NYCS = 0	number of spanwise AIC stations on control surface

YAIC(1,W) = 0.2' YAIC(2,W) = 0.7' YAIC(3, W) = 1.3'
YAIC(4,W) = 1.8'

XAIC(1,1,W) = 0.100' XAIC(1,2,W) = 0.700' XAIC(1,3,W) = 1.300'
XAIC(1,4,W) = 1.900'
XAIC(2,1,W) = 0.100' XAIC(2,2,W) = 0.700' XAIC(2,3,W) = 1.300'
XAIC(2,4W) = 1.900'
XAIC(3,1,W) = 0.380' XAIC(3,2.W) = 0.900' XAIC(3,3,W) = 1.405'
XAIC(3,4,W) = 1.915'
XAIC(4,1,W) = 0.860' XAIC(4,2,W) = 1.220' XAIC(4,3,W) = 1.580'
XAIC(4,4,W) = 1.940'

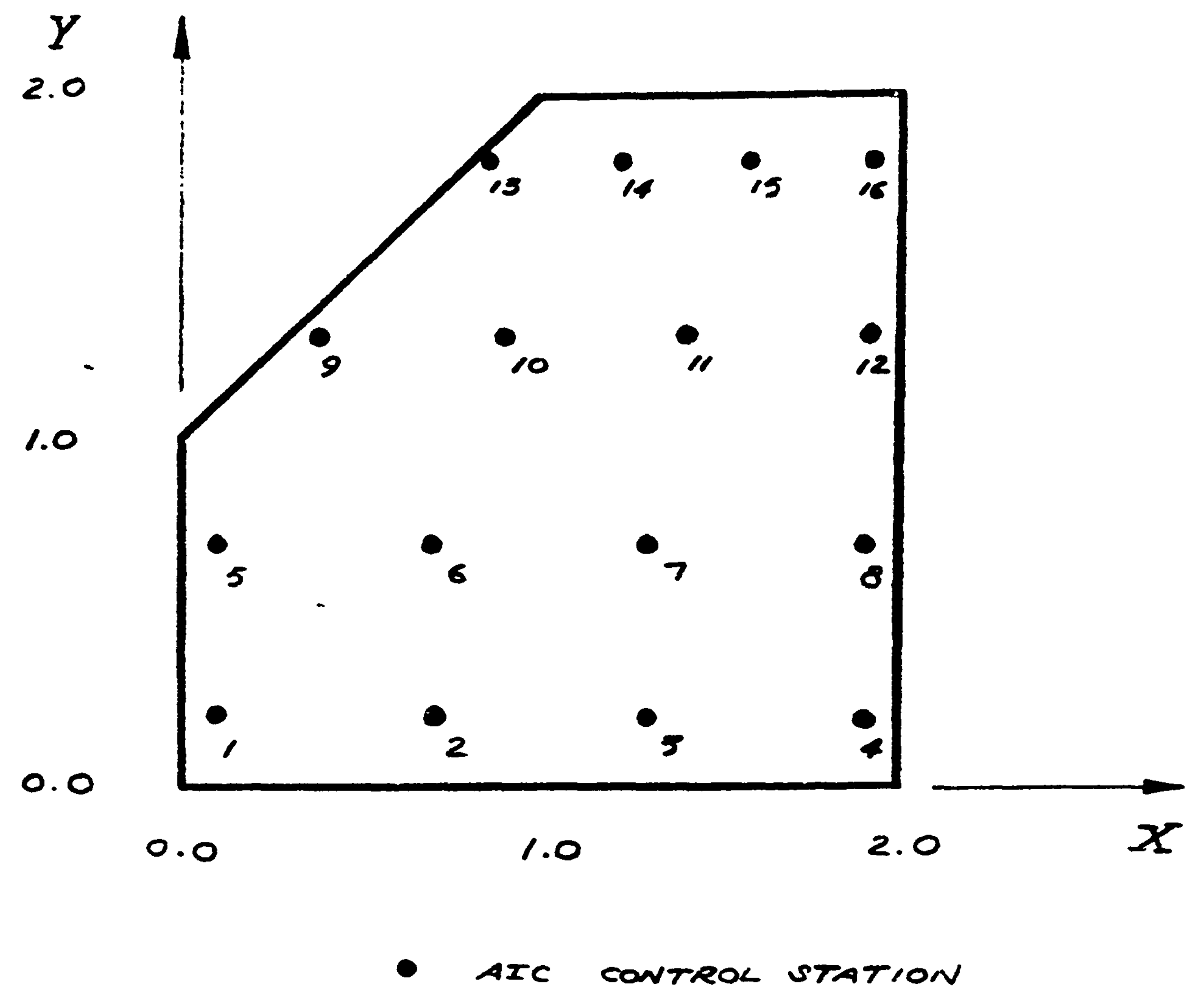


FIGURE 5. TRANSONIC SAMPLE PROBLEM 2.

```
                          DATA CARD COLUMN NUMBER
********************************************************************************
         11111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
********************************************************************************



0.0        1.0        2.0        2.0        2.0
0.0        1.0        2.0        1116.87
         1          1          1         .6          1
1.0                                                                   MACH NO.
0.1                                                                   RED FREQ
         4          4          0          0
0.200      0.700      1.300      1.800                                Y-WING
0.100      0.700      1.300      1.900      0.100      0.700          X-WING
1.300      1.900      0.380      0.900      1.405      1.915          X-WING
0.860      1.220      1.580      1.940                                X-WING



********************************************************************************
         11111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
********************************************************************************
                          DATA CARD COLUMN NUMBER
```

FIGURE 5.8. LISTING OF INPUT DATA CARDS FOR TRANSONIC SAMPLE PROBLEM 2.

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM

FLIGHT CONDITIONS AND GEOMETRY

MACH NUMBER = 1.00000   SPEED OF SOUND = 1116.870 L/T   RHO= 1.00

	WING	TAIL
L.E. STATION (L)	0.	2.000
ROOT CHORD (L)	2.000	0.
L.E. SPAN (L)	1.000	2.000
T.E. SPAN (L)	2.000	2.000
TIP CHORD (L)	1.000	0.
TOTAL AREA (L*L)	7.000	0.
CHORDWISE BOXES	6	0
SPANWISE BOXES	6	6

TOTAL CHORDWISE BOXES = 6   BOX CHORD = 3.63636E-01 L   BOX SPAN = 3.63636E-01 L

```
MAP OF SONIC BOX OVERLAY        SSSS
ON WING, TAIL AND WAKE          SSSSS
         (S) - WING             SSSSSS
         (S) - TAIL             SSSSSS
         (.) - WAKE             SSSSSS
                                SSSSSS
```

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT-D)

AIC COLLOCATION STATION COORDINATES ON THE WING

YAIC	XAIC VALUES--			
0.200000E 00	0.100000E 00	0.700000E 00	0.130000E 01	0.190000E 01
0.700000E 00	0.100000E 00	0.700000E 00	0.130000E 01	0.190000E 01
0.130000E 01	0.380000E 00	0.900000E 00	0.140500E 01	0.191500E 01
0.180000E 01	0.860000E 00	0.122000E 01	0.158000E 01	0.194000E 01

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT-D)

OSCILLATORY FREQUENCY (CPS) 1.77755E 01

REFERENCE CHORD 1.00000E 00

REDUCED FREQUENCY (REF. CHORD) 1.00000E-01

REDUCED VELOCITY (REF. CHORD) 1.00000E 01

FREE STREAM MACH NUMBER 1.00000E 00

FREE STREAM VELOCITY 1.11687E 03

DENSITY 1.00

DYNAMIC PRESSURE (1/2*RHO*VEL**2) 6.23699E 05

AERODYNAMIC INFLUENCE COEFFICIENTS

	RL	IM	RL	IM	RL	IM	RL	IM	RL	IM
ROW = 1										
	2.9104E 01	2.3762E-01	-1.2296E 01	-1.0361E 01	-1.5762E 01	7.0967E 00	-1.4645E 00	1.7125E-01	1.6124E 01	-4.8346E-01
	-1.2048E 01	-6.9629E 00	-3.5707E 00	5.921[illegible]E 00	-9.2102E-01	2.2773E-01	3.8597E 01	-3.1868E 01	-5.5868E 01	4.6386E 01
	1.9211E 01	-1.8351E 01	-2.7950E 00	2.4833E 00	-7.6487E 00	1.2229E 01	1.0147E 01	-1.6434E 01	-2.6938E 00	5.2075E 00
	4.8418E-01	-7.7325E-01								
ROW = 2										
	-4.7338E 01	2.3197E 01	1.5961E 02	-5.6834E 01	-1.4525E 02	4.0923E 01	3.2615E 01	-9.2195E 00	-1.3620E 01	1.7924E 01
	5.9559E 01	-4.8527E 01	-5.9686E 01	3.8015E 01	1.3524E 01	-8.5277E 00	1.5039E 01	2.9933E 00	2.6793E 00	-2.5067E 01
	-2.5165E 01	2.6321E 01	4.8522E 00	-5.6110E 00	1.9204E 01	-3.2240E 01	-3.5121E 01	5.1333E 01	1.7897E 01	-2.2250E 01
	-2.5335E 00	2.9051E 00								
ROW = 3										
	-5.1305E 01	7.3866E 00	9.7046E 01	1.3423E 01	-2.9771E 01	-3.6194E 01	-1.5398E 01	1.4881E 01	-2.6187E 01	5.8183E 00
	6.1281E 01	9.4583E 00	-3.3349E 01	-2.9080E 01	-1.3559E 00	1.3261E 01	-4.1237E 01	3.5261E 01	1.1855E 02	-6.3568E 01
	-9.5698E 01	2.9778E 01	1.8819E 01	-2.2753E 00	9.3089E 00	3.7355E 01	2.0658E 01	-9.3772E 01	-4.7685E 01	7.3217E 01
	1.7708E 01	-1.7545E 01								
ROW = 4										
	2.3167E 00	-7.9546E 00	-5.1672E 01	3.9852E 01	9.9043E 01	-4.7161E 01	-4.9326E 01	1.5160E 01	-2.0537E 00	-5.9038E 00
	-1.4526E 01	3.1150E 01	3.7929E 01	-3.9014E 01	-2.1786E 01	1.3654E 01	-1.0940E 01	-1.4258E 01	9.9149E 00	6.5317E 01
	1.7383E 01	-8.0637E 01	-1.6042E 01	2.9411E 01	-2.3009E 01	1.1462E 01	6.3921E 01	-1.1426E 01	-5.3772E 01	-7.3185E 00
	1.3[illegible]04E 01	7.1322E 00								
ROW = 5										
	2.5541E 01	-3.3473E 00	-2.0432E 01	-4.3619E 00	-4.1491E 00	5.2457E 00	-1.5078E 00	5.0943E-01	2.6007E 01	-5.9634E-01
	-1.3631E 01	-8.2974E 00	-1.1392E 01	6.1652E 00	-1.4298E 00	2.9934E-01	5.9906E 01	-3.5218E 01	-8.6860E 01	5.0854E 01
	3.0356E 01	-2.1428E 01	-4.3196E 00	2.7675E 00	-1.1732E 01	1.3794E 01	1.5464E 01	-1.8466E 01	-4.1415E 00	5.3810E 00
	7.3496E-01	-8.6966E-01								
ROW = 6										
	-2.0428E 01	2.2939E 01	8.8381E 01	-6.1071E 01	-8.8246E 01	4.7092E 01	2.0061E 01	-1.0573E 01	-3.5722E 01	2.0564E 01
	1.2980E 02	-5.4508E 01	-1.2168E 02	4.1483E 01	2.7379E 01	-9.3869E 00	1.8650E 01	2.9396E 00	9.7653E 00	-2.7674E 01
	-3.9298E 01	2.9035E 01	1.0211E 01	-6.2302E 00	3.1503E 01	-3.5601E 01	-5.5698E 01	5.6465E 01	2.7407E 01	-2.4516E 01

```
 -3.8222E 00  3.2049E 00

ROW = 7
 -3.8812E 01  8.9212E 00  8.6134E 01  9.0531E 00 -4.3278E 01 -3.4636E 01 -3.5284E 00  1.6037E 01 -4.3836E 01  6.6161E 00
  8.8204E 01  1.3275E 01 -3.2795E 01 -3.5590E 01 -1.1065E 01  1.5886E 01 -6.1644E 01  3.0756E 01  1.6846E 02 -7.1993E 01
 -1.5160E 02  3.2849E 01  2.5274E 01 -2.5349E 00  1.5155E 00  4.0645E 01  4.8302E 01 -1.0286E 02 -7.5764E 01  8.0790E 01
  2.5829E 01 -1.9464E 01

ROW = 8
 -2.2110E 00 -8.7486E 00 -2.3877E 01  4.3515E 01  5.7703E 01 -5.3342E 01 -3.1276E 01  1.8439E 01  8.4739E-01 -6.6719E 00
 -4.0281E 01  3.6079E 01  9.1185E 01 -4.4108E 01 -4.1402E 01  1.4568E 01 -8.4673E 00 -1.5341E 01 -7.0516E 00  7.2096E 01
  4.4719E 01 -8.9305E 01 -2.8824E 01  3.2349E 01 -2.7348E 01  1.3973E 01  7.4325E 01 -1.5257E 01 -6.0331E 01 -6.3386E 00
  1.3526E 01  7.4334E 00

ROW = 9
  1.3856E 01  1.8056E 00 -5.8472E 00 -1.5674E 01 -1.0364E 01  1.5409E 01  1.6893E 00 [illegible]7542E 00  1.2768E 01  2.7546E 00
  4.1323E 00 -1.6213E 01 -2.0475E 01  1.4356E 01  3.1805E 00 -2.5191E 00  4.9659E 01 -1.5930E 01 -5.0998E 01  1.5056E 01
  4.6699E-01 -1.3527E 00  2.2601E-01 -3.2728E-01  1.9834E 01 -3.8886E 00 -3.5836E 01  7.6729E 00  1.8667E 01 -4.7225E 00
 -2.6737E 00  7.1304E-01

ROW =10
 -1.5778E 01  2.2887E 01  6.1084E 01 -5.5574E 01 -5.7811E 01  3.9851E 01  1.2421E 01 -8.1426E 00 -2.7109E 01  1.8909E 01
  8.9062E 01 -4.6544E 01 -7.9539E 01  3.3574E 01  1.7475E 01 -6.9458E 00 -5.5748E 01  2.4746E 01  1.7104E 02 -6.1606E 01
 -1.4567E 02  4.3966E 01  3.0163E 01 -8.6383E 00  6.2655E 01 -3.1237E 01 -8.6281E 01  4.0612E 01  2.2504E 01 -1.0575E 01
  4.5544E-01 -2.2762E-01

ROW =11
 -1.4516E 01 -1.5932E 00  2.8844E 01  2.6004E 01 -8.3497E 00 -4.0074E 01 -5.6511E 00  1.5691E 01 -1.0663E 01 -1.8481E 00
  1.2721E 01  2.4452E 01  1.2298E 01 -3.6822E 01 -1.4027E 01  1.3942E 01 -5.8036E 01  1.5023E 01  1.2785E 02 -1.1442E 01
 -7.2251E 01 -1.1024E 01  2.8939E 00  7.0450E 00 -4.5751E 01  3.5483E 01  1.2870E 02 -7.4329E 01 -1.1007E 02  4.8196E 01
  2.7331E 01 -9.6679E 00

ROW =12
 -2.8039E 00 -5.8858E 00 -4.7594E 00  2.9352E 01  2.4543E 01 -3.6638E 01 -1.4768E 01  1.3058E 01 -1.9464E 00 -4.4864E 00
 -1.2669E 01  2.4211E 01  3.3706E 01 -3.0281E 01 -1.8874E 01  1.0444E 01  6.2737E 00 -9.6044E 00 -6.1351E 01  4.7741E 01
  1.0790E 02 -5.8562E 01 -9.2514E 01  2.0266E 01 -2.1016E 01  1.0345E 01  4.6808E 01 -1.1052E 01 -2.5529E 01 -4.3008E 00
 -2.0738E-01  4.8474E 00

ROW =13
 -4.7319E 00  5.2570E 00  1.6753E 01 -9.7899E 00 -1.3857E 01  3.6793E 00  1.8452E 00  5.4745E-01 -4.8585E 00  4.2234E 00
  1.6763E 01 -7.8909E 00 -1.3473E 01  2.7943E 00  1.5661E 00  5.6100E-01 -1.7988E 01  9.2698E 00  5.1421E 01 -1.9970E 01
 -3.9727E 01  1.1918E 01  6.2846E 00 -1.6790E 00 -2.8476E 01  7.7102E-01  8.9258E 01 -5.7658E 00 -7.9336E 01  6.0793E 00
  1.8456E 01 -1.5832E 00

ROW =14
 -4.1329E 00  6.7988E-02  7.1851E 00  6.5565E 00  1.1468E-01 -1.1364E 01 -3.0665E 00  4.6402E 00 -2.7366E 00  1.4793E-02
  2.4584E 00  6.0037E 00  5.3181E 00 -1.0181E 01 -4.9454E 00  4.0642E 00 -1.7598E 01  4.7818E 00  3.8555E 01 -3.7524E 00
 -2.1241E 01 -3.6051E 00  2.1584E-01  2.4342E 00 -3.8113E 01  4.6797E 00  7.8798E 01 -1.4618E 01 -3.9478E 01  6.6331E 00
 -1.1280E 00 -8.1711E-01

ROW =15
 -2.6742E-01 -1.9888E 00 -8.3309E 00  1.1167E 01  1.4085E 01 -1.4335E 01 -7.0923E 00  5.[illegible]101E 00 -9.[illegible]039E-01 -1.5823E 00
 -5.5255E 00  9.4447E 00  1.5041E 01 -1.2134E 01 -8.4229E 00  4.2248E 00  3.6441E-02 -2.[illegible]634E 00 -1.3249E 01  1.4461E 01
  4.3113E 01 -1.9184E 01 -2.[illegible]767E 01  5.7208E 00 -1.1517E 01  3.2806E 00 -8.2698E 00  3.1077E-01  5.3439E 01 -5.9360E 00
 -3.[illegible]445E 01  2.2849E 00

ROW =16
  3.3762E-01 -1.1221E [illegible] -7.[illegible]064E 0[illegible]  5.7689E 00  1.3444E 01 -6.2473E 00 -[illegible]225E 00  2.2837E [illegible]  3.[illegible]674E-[illegible] -2.[illegible]
 -7.3223E 00  4.8588E 00  1.3974E 01 -5.7608E 00 -6.9667E 00  1.7962E 00  1.2371E 00 -1.5620E 00 -1.9827E 01  8.6113E 00
  3.4509E 01 -1.1041E 01 -1.0542E 01  3.[illegible]81E 00  4.3247E 0[illegible]  3.0411E-02 -4.7676E 01  1.6736E [illegible]  7.5232E 01 -4.5[illegible]5E 00
 -3.5794E 0[illegible]  7.7425E-0[illegible]
```

Sample Problem 3.

Transonic AIC's are computed for a 45° delta wing at M = 1.01, f = 5.5 cps and a = 1116.87 ft/sec (sea level). Figure 5.9 shows the wing geometry and AIC stations. The trailing surface is removed from the analysis by setting X(5) = X(4) = X(3). There are 8 chordwise boxes on the wing and a total of 36 boxes in the overlay. Input parameters are summarized below and a listing of the data input cards and computer output follows.

X(1) = 0.0' X(2) = 2.0' X(3) = 2.0' X(4) = 2.0' X(5) = 2.0'
Y(1) = 0.0' Y(2) = 0.0' Y(3) = 2.0'

SOUND = 1116.87	acoustic velocity (sea level)
NMACH = 1	number of Mach numbers
KF = 0	input frequency
NFREQ = 1	number of frequencies
NBW = 8	number of chordwise boxes on wing
LPUNCH = 1	punch AIC matrix for wing on cards
FMACH (1) = 1.01	Mach number
FREQ (1) = 5.5	frequency (cps)
NXWING = 4	number of chordwise AIC stations on wing
NYWING = 4	number of spanwise AIC stations on wing
NXCS = 0	number of chordwise AIC stations on control surfac
NYCS = 0	number of spanwise AIC stations on control surface

YAIC(1,W) = 0.2' YAIC(2,W) = 0.6' YAIC(3,W) = 1.0'
YAIC(4,W) = 1.4'

XAIC(1,1,W) = 0.560' XAIC(1,2,W) = 0.920' XAIC(1,3,W) = 1.280'
XAIC(1,4,W) = 1.640'

XAIC(2,1,W) = 0.880' XAIC(2,2,W) = 1.160' XAIC(2,3,W) = 1.440'
XAIC(2,4,W) = 1.720'

XAIC(3,1,W) = 1.200' XAIC(3,2,W) = 1.400' XAIC(3,3,W) = 1.600'
XAIC(3,4,W) = 1.800'

XAIC(4,1,W) = 1.520' XAIC(4,2,W) = 1.640' XAIC(4,3,W) = 1.760'
XAIC(4,4,W) = 1.880'

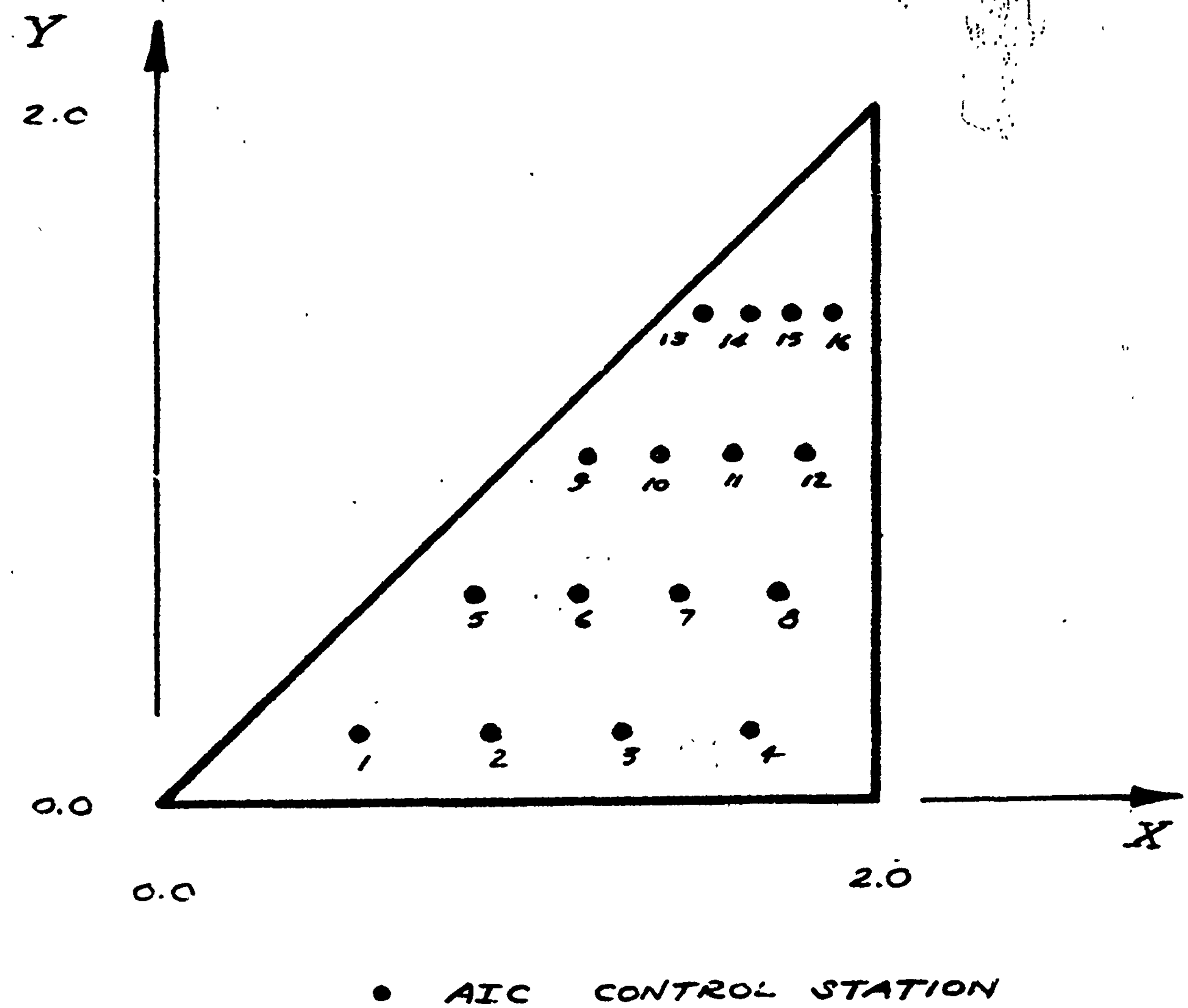


FIGURE 5. TRANSONIC SAMPLE PROBLEM 3.

```
                          DATA CARD COLUMN NUMBER
******************************************************************************
         111111111122222222223333333333444444444455555555556666666666777777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
******************************************************************************

0.0         2.0         2.0         2.0         2.0
0.0         0.0         2.0         1116.87
         1           0           1           8           1
1.01                                                                 MACH NO.
5.5                                                                  FREQ.
         4           4           0           0
0.2         0.6         1.3         1.4                              Y-WING
0.560       0.920       1.280       1.640       0.880       1.160    X-WING
1.440       1.720       1.200       1.400       1.600       1.800    X-WING
1.520       1.640       1.760       1.880                            X-WING

******************************************************************************
         111111111122222222223333333333444444444455555555556666666666777777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
******************************************************************************
                          DATA CARD COLUMN NUMBER
```

FIGURE 5.10. LISTING OF INPUT DATA CARDS FOR TRANSONIC SAMPLE PROBLEM 3.

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM

FLIGHT CONDITIONS AND GEOMETRY

MACH NUMBER = 1.01000   SPEED OF SOUND = 1116.870 L/T   RHO= 1.00

	WING	TAIL
L.E. STATION (L)	0.	2.000
ROOT CHORD (L)	2.000	0.
L.E. SPAN (L)	0.	2.000
T.E. SPAN (L)	2.000	2.000
TIP CHORD (L)	0.	0.
TOTAL AREA (L)	4.000	0.
CHORDWISE BOXES	8	0
SPANWISE BOXES	8	8

TOTAL CHORDWISE BOXES = 8   BOX CHORD = 2.66667E-01 L   BOX SPAN = 2.04026E-01 L

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT-D)

```
MAP OF SONIC BOX OVERLAY        S
ON WING, TAIL AND WAKE          SS
         (S) - WING             SSS
         ($) - TAIL             SSSS
         (,) - WAKE             SSSSS
                                SSS$SS
                                SSSSSSS
                                SSSSSSSS
```

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT-D)

AIC COLLOCATION STATION COORDINATES ON THE WING

YAIC	XAIC VALUES--			
0.200000E 00	0.560000E 00	0.920000E 00	0.128000E 01	0.164000E 01
0.600000E 00	0.880000E 00	0.116000E 01	0.144000E 01	0.172000E 01
0.100000E 01	0.120000E 01	0.140000E 01	0.160000E 01	0.180000E 01
0.140000E 01	0.152000E 01	0.164000E 01	0.176000E 01	0.188000E 01

HUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT-D)

OSCILLATORY FREQUENCY (CPS) 5.50000E 00

REFERENCE CHORD 1.00000E 00

REDUCED FREQUENCY (REF. CHORD) 3.06350E-02

REDUCED VELOCITY (REF. CHORD) 3.26424E 01

FREE STREAM MACH NUMBER 1.01000E 00

FREE STREAM VELOCITY 1.12804E 03

DENSITY 1.00

DYNAMIC PRESSURE (1/2*RHO*VEL**2) 6.36236E 05

AERODYNAMIC INFLUENCE COEFFICIENTS

RL	IM	RL	IM	RL	IM	RL	IM	RL	IM
ROW = 1									
8.7625E 02	-1.1397E 01	-1.0753E 03	8.5271E 00	2.6966E 02	-8.5442E 00	-6.4668E 01	3.1197E 00	7.0578E 02	-3.3613E 01
-1.4037E 03	5.7308E 01	7.5176E 02	-2.2638E 01	-5.3905E 01	-1.0970E 00	-2.6717E 02	2.3543E 01	5.0182E 02	-3.4844E 01
-2.4554E 02	8.2194E 00	1.0950E 01	3.0992E 00	3.6300E 01	-3.1156E 00	-6.0810E 01	1.9216E 00	2.0013E 01	4.4224E 00
4.4868E 00	-3.2528E 00								
ROW = 2									
-1.3155E 03	7.4571E 01	3.5483E 03	-1.7955E 02	-2.9693E 03	1.4356E 02	7.3662E 02	-4.0737E 01	1.2351E 03	-9.1500E 01
-2.2188E 03	1.3060E 02	1.1702E 03	-3.1686E 01	-1.8675E 02	-1.0726E 01	2.0406E 02	-3.2688E 01	-4.9194E 02	1.2332E 02
3.4127E 02	-1.3530E 02	-5.3316E 01	4.4423E 01	-1.5635E 02	3.1517E 01	3.0637E 02	-8.0707E 01	-2.2203E 02	8.3792E 01
7.2074E 01	-3.4178E 01								
ROW = 3									
-6.6675E 02	5.6674E 00	1.5654E 03	-4.0444E 01	-1.0073E 03	7.4283E 01	1.0864E 02	-4.0987E 01	-1.7183E 03	2.9736E 02
3.9982E 03	-3.9216E 02	-2.7001E 03	-1.3300E 02	4.1528E 02	2.2715E 02	1.3987E 03	-2.5877E 02	3.5362E 02	-6.2114E 02
-4.3700E 03	1.9738E 03	2.6169E 03	-1.0982E 03	4.3914E 01	-3.1424E 01	-2.3683E 03	9.8999E 02	4.2165E 03	-1.8171E 03
-1.8915E 03	8.6044E 02								
ROW = 4									
3.7474E 02	-6.1947E 01	-3.7324E 03	9.7544E 02	7.3237E 03	-2.0556E 03	-3.9162E 03	1.1398E 03	-7.0161E 02	8.9667E 01
1.5792E 04	-6.8663E 03	-3.5483E 04	1.6230E 04	2.0394E 04	-9.4492E 03	-5.7352E 02	-2.6690E 01	-3.2179E 04	1.6116E 04
8.3477E 04	-3.8418E 04	-4.7729E 04	2.2315E 04	-1.7294E 03	9.1998E 02	4.3099E 04	-1.9498E 04	-9.1589E 04	4.1035E 04
[illegible] 04	-2.2452E 04								
ROW = 5									
-4.[illegible]E 02	4.4962E 01	1.2297E 03	-1.1337E 02	-1.0341E 03	8.6319E 01	2.1116E 02	-2.0338E 01	5.4565E 02	-4.1591E 01
-6.6401E 02	5.3390E 01	1.3960E 02	-1.0996E 01	-2.1392E 01	-4.1806E 00	5.0097E 02	-2.6982E 01	-9.3356E 02	6.9798E 01
5.[illegible]673E 02	-6.3875E 01	-8.4159E 01	1.9694E 01	-1.1811E 02	1.4501E 01	2.2396E 02	-3.6124E 01	-1.5244E 02	3.6924E 01
4.4627E 01	-1.4957E 01								
ROW = 6									
-3.7347E 02	3.3435E 01	9.8109E 02	-7.7250E 01	-7.2575E 02	5.1440E 01	1.1810E 02	-8.9662E 00	-1.0065E 03	9.3536E 01
2.9534E 03	-2.9664E 02	-2.7283E 03	3.1460E 02	7.8135E 02	-1.1272E 02	1.0671E 03	-1.4702E 02	-2.2896E 03	4.0117E 02
1.7047E 03	-4.1095E 02	-5.0237E 02	1.5433E 02	-9.0373E 02	4.9706E 01	5.4473E 02	-1.7668E 02	-6.0528E 02	2.3586E 02

```
2.6428E 02 -1.0841E 02

ROW = 7
 1.4002E 02 -5.3032E 01 -4.7937E 02  1.1729E 02  6.3413E 02 -7.2575E 01 -2.9484E 02  7.1756E 00 -1.2834E 03  1.7754E 02
 1.4670E 03  1.0368E 02  5.5383E 02 -7.6480E 02 -9.6721E 02  4.8282E 02 -3.2908E 02  2.0391E 01  5.4614E 03 -1.5128E 03
-9.4630E 03  2.9726E 03  4.3300E 03 -1.4841E 03  7.1349E 02 -1.6346E 02 -4.3456E 03  1.4535E 03  6.4518E 03 -2.4321E 03
-2.8194E 03  1.1428E 03

ROW = 8
 6.9638E 01 -1.2039E 01 -1.9772E 03  5.8578E 02  4.3145E 03 -1.3219E 03 -2.4071E 03  7.4654E 02  2.9146E 02 -7.6132E 01
 9.1765E 03 -4.2303E 03 -2.3224E 04  1.0400E 04  1.3757E 04 -6.0919E 03 -7.7872E 02  4.5696E 01 -2.4985E 04  1.0864E 04
 6.1724E 04 -2.5686E 04 -3.6012E 04  1.4769E 04 -1.4361E 03  6.3602E 02  3.2608E 04 -1.2970E 04 -6.7515E 04  2.6895E 04
 3.6344E 04 -1.4560E 04

ROW = 9
-7.0142E 01  1.8919E 00  2.2396E 02  5.6743E 00 -6.1709E 01 -2.4716E 01 -8.6206E 01  1.5347E 01 -6.8257E 02  8.9669E 01
 1.4189E 03 -1.2108E 02 -6.4727E 02 -3.7622E 01 -8.9045E 01  6.7980E 01  3.9758E 01 -4.1138E 01  1.7987E 03 -2.1051E 02
-3.0892E 03  5.1218E 02  1.2545E 03 -2.6445E 02  3.2135E 02 -3.1037E 01 -1.3159E 03  2.6739E 02  1.7019E 03 -4.4737E 02
-7.0729E 02  2.1093E 02

ROW =10
 4.5586E 01 -1.3382E 01 -2.7404E 02  6.2048E 01  4.7212E 02 -8.6968E 01 -2.4370E 02  3.7651E 01 -1.9744E 02  1.0275E 01
 4.0994E 02  5.1865E 00 -2.1315E 02 -3.3268E 01  6.4565E-01  1.7468E 01 -5.6787E 02  5.2291E 01  1.1199E 03 -1.1031E 02
-2.8609E 02  3.9135E 01 -2.6607E 02  1.7740E 01  2.3499E 02 -3.6424E 01 -3.9682E 01  2.8934E 01 -4.2610E 02  3.1546E 01
 2.3069E 02 -2.4975E 01

ROW =11
 2.0174E 01 -7.0390E 00 -2.9245E 02  6.5264E 01  5.5966E 02 -1.1445E 02 -2.9342E 02  5.5670E 01  4.0889E 01 -2.6586E 01
 7.5836E 01 -5.2061E 01 -2.5705E 02  2.1730E 02  1.4030E 02 -1.3913E 02 -5.2114E 02  6.6667E 01 -2.6294E 02  2.8505E 02
 2.2602E 03 -8.3958E 02 -1.4765E 03  4.8740E 02  1.2237E 02 -7.3359E 00  9.5517E 02 -4.0260E 02 -1.9765E 03  4.3035E 02
 8.9876E 02 -4.2180E 02

ROW =12
 1.1626E 01  7.3377E-01 -3.2677E 02  4.1916E 01  5.9099E 02 -6.5773E 01 -2.7587E 02  2.2460E 01  5.3610E 02 -1.2707E 02
-2.8402E 03  5.3936E 02  5.0250E 03 -8.8048E 02 -2.7212E 03  4.6641E 02 -7.6936E 02  1.7188E 02  2.0654E 03 -5.0607E 02
-3.7694E 03  9.4752E 02  2.4740E 03 -6.1126E 02  4.0297E 02 -6.8342E 01 -3.4641E 03  5.4237E 02  8.0860E 03 -1.3480E 03
-5.0257E 03  8.6971E 02

ROW =13
-6.9935E 00 -3.1123E 00 -3.1336E 02  8.1311E 04  7.7256E 02 -1.7323E 02 -4.5067E 02  9.4293E 01  2.3511E 02 -2.3230E 01
 1.3609E 03 -3.4374E 02 -3.9127E 03  8.9274E 02  2.2467E 03 -5.2618E 02 -8.1305E 02  4.5824E 01 -3.1925E 03  9.7886E 02
 1.0070E 04 -2.4121E 03 -6.0644E 03  1.3865E 03 -4.3258E 02  4.3922E 01  6.5544E 03 -1.2033E 03 -1.2176E 04  2.4733E 03
 6.1538E 03 -1.3157E 03

ROW =14
-4.9315E 00  4.2278E-02  9.4374E 01 -8.2091E 00 -2.2962E 02  2.7530E 01  1.4017E 02 -1.9536E 01  1.5820E 02 -2.7631E 01
-1.8752E 03  3.0637E 02  4.0006E 03 -6.4516E 02 -2.2836E 03  3.6551E 02 -3.0675E 02  4.3101E 01  3.3040E 03 -5.6857E 02
-8.2674E 03  1.2682E 03  4.7704E 03 -7.4130E 02  2.0118E 02 -4.4301E 01 -4.2686E 03  6.6184E 02  9.4684E 03 -1.4225E 03
-5.4013E 03  8.0300E 02

ROW =15
- . 2[illegible] [illegible]  1.4797E-01  3.3031E 02 -2.8732E 01 -8.3369E 02  9.6355E 01  4.9060E 02 -6.8377E 01  5.5368E 02 -4.6709E 01
- . [illegible]633E 03  1.0723E 03  1.4002E 04 -2.2580E 03 -7.9927E 03  1.2793E 03 -1.0736E 03  1.5065E 02  1.3314E 04 -1.9900E 03
- . 936E 04  4.4387E 03  1.0096E 04 -2.5946E 03  7.3412E 02 -1.5505E 02 -1.4940E 04  2.3165E 03  3.3139E 04 -4.0786E 03
- . [illegible]904E 04  2.8135E 03

ROW =16
-[illegible] 35[illegible]E 00  1.0396E 00  3.7156E 02 -5.4798E 01 -9.2660E 02  1.4822E 02  5.6486E 02 -9.4682E 01  3.9145E 02 -7.2261E 01
-[illegible]640E 03  1.0425E 03  1.3331E 04 -2.2603E 03 -7.6387E 03  1.2875E 03 -6.0419E 02  1.0535E 02  1.2256E 04 -2.0527E 03
-[illegible]699E 04  4.6831E 03  1.6249E 04 -2.7312E 03  8.2078E 02 -1.4514E 02 -1.5324E 04  2.4329E 03  3.2886E 04 -5.1872E 03
-1.6392E 04  2.8943E 03
```

PART V - SECTION B4.0

LISTING OF TRANSONIC AIC COMPUTER PROGRAM

```
CMAIN        MAIN
      COMPLEX Z,W,F,VPIC,DS,PHIW,CK,CZERO,PHI,PHITE,DPHI,
     1        SPHI,ASQ,EXF,AIC
      DIMENSION ASQ(40,40),F(45,45),S(45,45),R(45,45),C(45,45),B(45,45),
     1          T(45,45),TEMP(45,45),TM(45,45),TI(45,45),TR(45,45)
      COMMON/C1/KBOX(1000),XE(5),YE(3),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH
      COMMON/C3/VPIC(80,15),DS(2025),PHIW(50),CK(40),DXE(6),TPI,KF
      COMMON/C4/MOR(100),NBL(100),FQ,IFR,XL,NS,NTM,NBW,NBT
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,MP,NB,NBOX,KODE,MODE
      COMMON/C6/CZERO,PHI,PHITE,DPHI,SPHI,RHO,NXCS,NYCS,NYBX(40)
      COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NYWING,NYWING
      COMMON/C9/W(45,45),AIC(45,45)
      EQUIVALENCE (C,S,R),(ASQ,W,B),(DS,F,TM),(AIC,TEMP)
    1 CALL DAIN
      IF (NMODE .LE. 45) GO TO 5
      WRITE (6,8)
    8 FORMAT (1H1,5X,50H NUMBER OF AIC STATIONS EXCEEDS MAX ALLOWABLE (4
     15)/5X,16H CASE TERMINATED)
      GO TO 1
    5 CONTINUE
      DO 1000 MACH=1,NMACH
      EM = FMACH(MACH)
      IF(ABS(EM-1.0).GT.0.05) GO TO 1000
      CALL CODE
      CALL POUT(1)
      CALL POUT(2)
      NTRS=0
      DO 7 I=1,NBS
    7 NTRS=NTRS+NXBX(I)+NXBXCS
      IF (NTRS .LE. 45) GO TO 17
      WRITE (6,14)
   14 FORMAT(1H1,5X,48H NUMBER OF MACH BOXES EXCEEDS MAX ALLOWABLE (45)
     1/5X,16H CASE TERMINATED)
      GO TO 1
   17 CONTINUE
      TPU=TPI/(AS*EM)
      RFM = DX
      CALL TRAMP (2,NTRS,NTCS,S,R,C,B,T,TR,TI,TM)
      DO 550 I=1,NTRS
      DO 550 J=1,NTCS
  550 TEMP(I,J)=TR(I,J)
      CALL TRAMP (1,NTRS,NTCS,S,R,C,B,T,TR,TI,TM)
      DO 560 I=1,NTRS
      DO 560 J=1,NTCS
  560 TR(I,J)=TEMP(I,J)
      DO 900 IFR =1,NFREQ
      IF (KF .EQ. 1) FREQ(IFR)=FREQ(IFR)*FMACH(MACH)*AS/(TPI*X1*0.5)
      EK=FREQ(IFR)*TPU
      IF(EK.EQ.0.0) GO TO 900
      EKB  =EK*RFM
      EKR = EK*X1/2.0
      NMODE=NTCS
      CALL POT2H
      ARG=EK*DX
      EXF=CMPLX(COS(ARG),-SIN(ARG))
      DO 600 MODE=1,NMODE
      X=0.5*DX
      NB=1
      DO 701 NP=1,NBOX
      MB=MOB(NP)
```

```
      Y=0.0
      KODE = KBOX(NB)
      NS =1
      GO TO (12,11,12,11,11,120),KODE
   11 NS =2
   12 DO 20 MP=1,MB
      SPHI = CZERO
      IF(NP.GT.1) CALL PHIB
      IF (NS .EQ. 2) GO TO 13
      IR=0
      DO 21 IL=1,MP
   21 IR=IR+NXBX(IL)
      IR=IR+NP-NXBX(1)
      GO TO 26
   13 IR=0
      DO 22 IL=1,NBS
   22 IR=IR+NXBX(IL)
      DO 23 IL=1,MP
   23 IR=IR+NXBXCS
      IR=IR-NBOX+NP
   26 SR=TR(IR,MODE)
      SI=TI(IR,MODE)*TPI*FREQ(IFR)/(FM*AS)
      CK(MP)=CMPLX(SR,SI)
      DS(NB)=CK(MP)
      DS(NB) = DS(NB) - SPHI
      Y = Y+DY
   20 NB = NB+1
      NB = NB-MB
      DO 30 IQ=1,MB
      DO 30 JQ=1,MB
      IJQ = IABS(IQ-JQ)+1
   25 ASQ(IQ,JQ) = VPIC(IJQ,1)
      IF(JQ.EQ.1) GO TO 30
      IJQ=IQ+JQ-1
      ASQ(IQ,JQ)=ASQ(IQ,JQ)+VPIC(IJQ,1)
   30 CONTINUE
      LSQ=MSIMEQ(40,MB,1,ASQ,DS(NB))
      IF(LSQ.EQ.1) GO TO 39
      GO TO  900
   39 CONTINUE
      Y = 0.0
      IF(NP.NE.1) GO TO 50
      DO 45 MP=1,MB
   45 DS(MP) = DS(MP)*2.0/3.1415927
   50 CONTINUE
      IF (KODE.NE.4) GO TO 80
      DO 60 MP=1,MB
      DS(NB) = PHIW(MP)+(DS(NB)-PHIW(MP))*2.0/3.1415927
   60 NB=NB+1
      NB=NB-MB
   80 CONTINUE
      DO 100 MP=1,MB
      IF(KODE.EQ.3) PHIW(MP)=DS(NB)*EXF
      IF(NP.EQ.NBOX-1) PHIW(MP)=DS(NB)
      PHITE = DS(NB)
      IF(NP.EQ.NBOX) PHITE = PHITE+(PHITE-PHIW(MP))*DXE(5)
      PHI = DS(NB)
      GO TO (128,121,128,121,121,127),KODE
  128 IC=0
      DO 122 IL=1,MP
  122 IC=IC+NXBX(IL)
```

```
      IC=IC+NP-NXBX(1)
      GO TO 126
121   IC=0
      DO 123 IL=1,NBS
123   IC=IC+NXBX(IL)
      DO 124 IL=1,MP
124   IC=IC+NXBXCS
      IC=IC-NBOX+NP
126   AIC(IC,MODE)=DS(NB)/FM
127   CONTINUE
      NB = NB + 1
100   Y=Y+DY
      GO TO 200
120   DO 130 MP=1,MB
      DS(NB)=PHIW(MP)
      PHIW(MP) = FXF*PHIW(MP)
      CK(MP)=CZERO
130   NB = NB+1
200   X = X+DX
500   CONTINUE
      CALL SD2 (S,R,C,B,T,TR,TM)
      DO 701 I=1,NTRS
      DO 701 J=1,NTRS
      SI=0.0
      IF (I .EQ. J) SI=TPI*FREQ(IFR)/(FM*AS)
      SR=TM(I,J)
701   W(I,J)=CMPLX(SR,SI)
      DO 702 I=1,NTRS
      DO 702 J=1,NTCS
      F(I,J)=(0.0,0.0)
      DO 702 K=1,NTRS
702   F(I,J)=F(I,J)+W(I,K)*AIC(K,J)
      CALL FORCE (R)
      DO 708 I=1,NTCS
      DO 708 J=1,NTCS
      AIC(I,J)=(0.0,0.0)
      DO 708 K=1,NTRS
      Z=CMPLX(C(I,K)*FO/(0.5*(TPI*FREQ(IFR))**2*(YE(3)-YE(1))*(XE(3)-XE(
     11))**2),0.0)
708   AIC(I,J)=AIC(I,J)-Z*F(K,J)
      CALL POUT(3)
      IF (IPUNCH .GT. 0) CALL POUT(4)
900   CONTINUE
1000  CONTINUE
      GO TO 1
      END
```

```
CFORCE       FORCE
      SUBROUTINE FORCE (R)
      COMPLEX CZERO,PHI,PHITE,DPHI,SPHI
      COMPLEX VPIC,DS,PHIW,CK
      DIMENSION R(45,45)
      COMMON/C1/KBOX(1000),XE(5),YE(3),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH
      COMMON/C3/VPIC(80,15),DS(2025),PHIW(50),CK(40),DXE(6),TPI,KF
      COMMON/C4/MOB(100),NBL(100),FQ,IFR,XL,NS,NTM,NBW,NBT
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,MP,NB,NBOX,KODE,MO
      COMMON/C6/CZERO,PHI,PHITE,DPHI,SPHI,RHO,NXCS,NYCS,NYBX(
      COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NXWING,NYWING
      NSUB=NXBX(1)
      MB=MOB(NBOX)
      NMBXW=0
      DO 50 I=1,MB
   50 NMBXW=NMBXW+NXBX(I)
      KROW=NXWING*NYWING+NXCS*NYCS
      KCOL=0
      DO 100 I=1,MB
  100 KCOL=KCOL+NXBX(I)+NXBXCS
      DO 150 I=1,KROW
      DO 150 J=1,KCOL
  150 R(I,J)=0.0
      DO 600 I=1,MB
      NCK=0
      FRB=1.0
      FRT=1.0
      FOF = 1.0
      YR=DY*FLOAT(I)-DY
      II=NYWING-1
      DO 610 III=1,II
      IF (0.5*(YAIC(III,1)+YAIC(III+1,1))-YE(1) .GT. YR-.5*DY) GO TO 630
  610 CONTINUE
      III=NYWING
      GO TO 620
  630 CONTINUE
      IF (YR-0.5*DY .LT. 0.5*(YAIC(III,1)+YAIC(III+1,1))-YE(1) .AND.
     1    YR+0.5*DY .GT. 0.5*(YAIC(III,1)+YAIC(III+1,1))-YE(1)) NCK=1
      IF (NCK .EQ. 0) GO TO 620
      FRB=(0.5*(YAIC(III,1)+YAIC(III+1,1))-YE(1)-YR+0.5*DY)/DY
      FRT=1.0-FRB
  620 NROW=NXWING*(III-1)
      NCOL=0
      DO 650 IIII=1,I
  650 NCOL=NCOL+NXBX(IIII)
      NCOL=NCOL-NXBX(I)
      KK=NXBX(I)
      DO 750 K=1,KK
      DO 700 J=1,NXWING
      IF (XAIC(1,III,1)-XE(1) .GE. (FLOAT(NXBX(1)-NXBX(I)+K)-.5)*DX)
     1GO TO 710
      IF (XAIC(NXWING,III,1)-XE(1) .LE. (FLOAT(NXBX(1)-NXBX(I)+K)-.5)*
     1DX) GO TO 720
      IF (XAIC(J,III,1)-XE(1) .GT. (FLOAT(NXBX(1)-NXBX(I)+K)-.5)*DX)
     1GO TO 730
  700 CONTINUE
  710 NRF=NROW+1
      NCF=NCOL+K
      R(NRF,NCF)=FRB
      IF (I .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*0.5
```

```
      IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
      IF (I .EQ. MR) FOE = (YE(3)-YE(1)-(FLOAT(MR)-1.5)*DY)/DY
      IF (I .EQ. MR) R(NRF,NCF)=R(NRF,NCF)*FOE
      GO TO 740
720   NRF=NROW+NXWING
      NCF=NCOL+K
      R(NRF,NCF)=FRB
      IF (I .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*0.5
      IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
      IF (I .EQ. MR) FOE = (YE(3)-YE(1)-(FLOAT(MR)-1.5)*DY)/DY
      IF (I .EQ. MR) R(NRF,NCF)=R(NRF,NCF)*FOE
      GO TO 740
730   R1=XAIC(J,III,1)-XE(1)-(FLOAT(NXBX(1)-NXBX(I)+K)-0.5)*DX
      R3=XAIC(J,III,1)-XAIC(J-1,III,1)
      NRF=NROW+J
      NCF=NCOL+K
      R(NRF,NCF)=(1.0-R1/R3)*FRB
      R(NRF-1,NCF)=(R1/R3)*FRB
      IF (I .EQ. 1) R(NRF,NCF)=0.5*R(NRF,NCF)
      IF (I .EQ. 1) R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
      IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
      IF (K .EQ. KK) R(NRF-1,NCF)=R(NRF-1,NCF)*0.5
      IF (I .EQ. MR) FOE = (YE(3)-YE(1)-(FLOAT(MR)-1   )*DY)/DY
      IF (I .EQ. MR) R(NRF,NCF)=R(NRF,NCF)*FOE
      IF (I .EQ. MR) R(NRF-1,NCF)=R(NRF-1,NCF)*FOE
740   CONTINUE
      IF (NCK .EQ. 1 .AND. K .EQ. KK) GO TO 760
      GO TO 750
760   DO 850 KT=1,KK
      DO 800 JT=1,NXWING
      IF (XAIC(1,III+1,1)-XE(1) .GE. (FLOAT(NXBX(1)-NXBX(I)+KT)-.5)*DX)
     1GO TO 810
      IF (XAIC(NXWING,III+1,1)-XE(1) .LE. (FLOAT(NXBX(1)-NXBX(I)+KT)-.5)
     1*DX) GO TO 820
      IF (XAIC(JT,III+1,1)-XE(1) .GT. (FLOAT(NXBX(1)-NXBX(I)+KT)-.5)*DX)
     1GO TO 830
800   CONTINUE
810   NRF=NROW+NXWING+1
      NCF=NCOL+KT
      R(NRF,NCF)=FRT*FOE
      IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
      GO TO 840
820   NRF=NROW+2*NXWING
      NCF=NCOL+KT
      R(NRF,NCF)=FRT*FOE
      IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
      GO TO 840
830   R1=XAIC(JT,III+1,1)-XE(1)-(FLOAT(NXBX(1)-NXBX(I)+KT)-0.5)*DX
      R3=XAIC(JT,III+1,1)-XAIC(JT-1,III+1,1)
      NRF=NROW+NXWING+JT
      NCF=NCOL+KT
      R(NRF,NCF)=(1.0-R1/R3)*FRT*FOE
      R(NRF-1,NCF)=(R1/R3)*FRT*FOE
      IF (I .EQ. 1) R(NRF,NCF)=0.5*R(NRF,NCF)
      IF (I .EQ. 1) R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
      IF (KT .EQ. KK) R(NRF,NCF)=0.5*R(NRF,NCF)
      IF (KT .EQ. KK)   NRF-1,NCF)=0.5*R(NRF-1,NCF)
840   CONTINUE
850   CONTINUE
750   CONTINUE
600   CONTINUE
```

```
      DO 400 I=1,MB
      KK=NXBXCS
      NCK=0
      FRB=1.0
      FRT=1.0
      FOF = 1.0
      YR=DY*FLOAT(I)-DY
      II=NYCS-1
      DO 410 III=1,II
      IF (0.5*(YAIC(III,2)+YAIC(III+1,2))-YE(1) .GT. YR-.5*DY) GO TO 430
  410 CONTINUE
      III=NYCS
      GO TO 420
  430 CONTINUE
      IF (YR-0.5*DY .LT. 0.5*(YAIC(III,2)+YAIC(III+1,2))-YE(1) .AND.
     1     YR+0.5*DY .GT. 0.5*(YAIC(III,2)+YAIC(III+1,2))-YE(1)) NCK=1
      IF (NCK .EQ. 0) GO TO 420
      FRB=(0.5*(YAIC(III,2)+YAIC(III+1,2))-YE(1)-YR+0.5*DY)/DY
      FRT=1.0-FRB
  420 NROW=NXWING*NYWING+NXCS*(III-1)
      NCOL=NMBXW+(I-1)*NXBXCS
      DO 950 K=1,NXBXCS
      DO 900 J=1,NXCS
      IF (XAIC(1,III,2)-XE(1) .GE. (FLOAT(NBOX-NXBXCS+K)-.5)*DX)
     1GO TO 910
      IF (XAIC(NXCS,III,2)-XE(1) .LE. (FLOAT(NBOX-NXBXCS+K)-.5)*DX)
     1GO TO 920
      IF (XAIC(J,III,2)-XE(1) .GT. (FLOAT(NBOX-NXBXCS+K)-.5)*DX)
     1GO TO 930
  900 CONTINUE
  910 NRF=NROW+1
      NCF=NCOL+K
      R(NRF,NCF)=FRB
      IF (I .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*0.5
      IF (K .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*((FLOAT(NBOX-NXBXCS+1))*DX
     1-XE(4)+XE(1))/DX
      IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)-(FLOAT(NBOX-1))*
     1DX)/DX
      IF (I .EQ. MB) FOE=(YE(3)-YE(1)-(FLOAT(MB)-1.5)*DY)/DY
      IF (I .EQ.MB) R(NRF,NCF)=R(NRF,NCF)*FOE
      GO TO 940
  920 NRF=NROW+NXCS
      NCF=NCOL+K
      R(NRF,NCF)=FRB
      IF (I .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*0.5
      IF (K .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*((FLOAT(NBOX-NXBXCS+1))*DX-
     1XE(4)+XE(1))/DX
      IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)-(FLOAT(NBOX-1))*
     1DX)/DX
      IF (I .EQ. MB) FOF = (YE(3)-YE(1)-(FLOAT(MB)-1.5)*DY)/DY
      IF (I .EQ.MB) R(NRF,NCF)=R(NRF,NCF)*FOF
      GO TO 940
  930 R1=XAIC(J,III,2)-XE(1)-(FLOAT(NBOX-NXBXCS+K)-.5)*DX
      R3=XAIC(J,III,2)-XAIC(J-1,III,2)
      NRF=NROW+J
      NCF=NCOL+K
      R(NRF,NCF)=(1.0-R1/R3)*FRB
      R(NRF-1,NCF)=(R1/R3)*FRB
      IF (I .EQ. 1) R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
      IF (I .EQ. 1) R(NRF,NCF)=0.5*R(NRF,NCF)
      IF (K .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*( FLOAT(NBOX-NXBXCS+K)*DX
```

```
     1-XF(4)+XE(1))/DX
      IF (K .EQ. 1) R(NRF-1,NCF)=R(NRF-1,NCF)*( FLOAT(NBOX-NXBXCS+K)*DX
     1-XF(4)+XF(1))/DX
      IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*( XF(5)-XF(1)- FLOAT(NBOX-1)*
     1DX)/DX
      IF (K .EQ. KK) R(NRF-1,NCF)=R(NRF-1,NCF)*(XE(5)-XE(1)-
     1FLOAT(NBOX-1)*DX)/DX
      IF (I .EQ. MB) FOE = (YE(3)-YE(1)-(FLOAT(MB)-1.5)*DY)/DY
      IF (I .EQ. MB) R(NRF,NCF)=R(NRF,NCF)*FOE
      IF (I .EQ. MB) R(NRF-1,NCF)=R(NRF-1,NCF)*FOE
  940 CONTINUE
      IF (NCK .EQ. 1 .AND. K .EQ. KK) GO TO 960
      GO TO950
  960 DO 350 KT=1,KK
      DO 300 JT=1,NXCS
      IF (XAIC(1,III+1,2)-XE(1) .GE. (FLOAT(NBOX-NXBXCS+KT)-.5)*DX)
     1GO TO 310
      IF (XAIC(NXCS,III+1,2)-XE(1) .LE. (FLOAT(NBOX-NXBXCS+KT)-.5)*DX)
     1GO TO 320
      IF (XAIC(JT,III+1,2)-XF(1) .GT. (FLOAT(NBOX-NXBXCS+KT)-.5)*DX)
     1GO TO 330
  300 CONTINUE
  310 NRF=NROW+NXCS+1
      NCF=NCOL+KT
      R(NRF,NCF)=FRT*FOE
      IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XF(1)- FLOAT(NBOX-1)*
     1DX)/DX
      IF (KT .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*( FLOAT(NBOX-NXBXCS+1)*DX
     1-XF(4)+XE(1))/DX
      GO TO340
  320 NRF=NROW+2*NXCS
      NCF=NCOL+KT
      R(NRF,NCF)=FRT*FOE
      IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)- FLOAT(NBOX-1)*
     1DX)/DX
      IF (KT .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*( FLOAT(NBOX-NXBXCS+1)*DX
     1-XF(4)+XE(1))/DX
      GO TO 340
  330 R1=XAIC(JT,III+1,2)-XE(1)-(FLOAT(NBOX-NXBXCS+KT)*DX-.5*DX)
      R3=XAIC(JT,III+1,2)-XAIC(JT-1,III+1,2)
      NRF=NROW+NXCS+JT
      NCF=NCOL+KT
      R(NRF,NCF)=(1.0-R1/R3)*FRT*FOE
      R(NRF-1,NCF)=(R1/R3)*FRT*FOE
      IF (I .EQ. 1) R(NRF,NCF)=0.5*R(NRF,NCF)
      IF (I .EQ. 1) R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
      IF (KT .EQ. 1) R(NRF,NCF)=R(NRF,NCF)* (FLOAT(NBOX-NXBXCS+1)*DX-
     1XF(4)+XF(1))/DX
      IF (KT .EQ. 1) R(NRF-1,NCF)=R(NRF-1,NCF)*(FLOAT(NBOX-NXBXCS+1)*DX-
     1XF(4)+XF(1))/DX
      IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)-FLOAT(NBOX-1)*
     1DX)/DX
      IF (KT .EQ. KK) R(NRF-1,NCF)=R(NRF-1,NCF)*(XF(5)-XF(1)-FLOAT(NBOX-
     11)*DX)/DX
  340 CONTINUE
  350 CONTINUE
  950 CONTINUE
  400 CONTINUE
      RETURN
      END
```

```
CCODE         CODE
      SUBROUTINE CODE
      COMPLEX CZERO,PHI,PHITE,DPHI,SPHI
      COMPLEX VPIC,DS,PHIW,CK
      COMMON/C1/KBOX(1000),XE(5),YE(3),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH
      COMMON/C3/VPIC(80,15),DS(2025),PHIW(50),CK(40),DXE(6),TPI,KF
      COMMON/C4/ JR(100),NBL(100),FQ,IFR,XL,NS,NTM,NBW,NBT
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,FKR,NP,MP,NB,NBOX,KODE,MODE
      COMMON/C6/CZERO,PHI,PHITE,DPHI,SPHI,RHO,NXCS,NYCS,NYBX(40)
      COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NXWING,NYWING
      BETA = EM
      X1 = XE(3) - XE(1)
      X2 = XE(3) - XE(2)
      X3 = XE(4) - XE(1)
      X4 = XE(5) - XE(4)
      X5 = XE(5) - XE(1)
      Y1 = YE(2) - YE(1)
      Y2 = YE(3) - YE(1)
      IF(X2.GT.X1.OR.X1.GT.X3.OR.X3.GT.X5.OR.X2.LT.0.0) GO TO 50
      IF(Y1.GT.Y2.OR.Y1.LT.0.0) GO TO 50
      TWL = 0.0
      IF(Y2.NE.Y1)  TWL = (X1 - X2) / (Y2 - Y1)
      AR(1) =         (Y2*(X2+X1) - Y1 * (X2-X1))
      AR(2) = Y2*X4*2.0
      AR(3) = AR(1) + AR(2)
   10 DX = X1/(FLOAT(NBW) -0.5)
      IF (100.0* DX .GT. X5) GO TO 20
   15 NBW = NBW-1
      GO TO 10
   20 DY = DX/BETA
      YN1 = Y1/DY
      YN2 = Y2/DY
      XNL = YN2 - (X1-X2) / DX
      XNT = YN2 + X5/DX
      XNLE = X3/DX
      XNTE     = X5/DX
      NBOX=XNTE+0.5000001
      NBS = Y2/DY + 1.0
      NBT = X4/DX + 0.5
      DXE(1) = 1.0
      DXE(2) = 1.0
      DXE(3) = 0.5
      DXE(4) = AINT(XNLE + 1.5) - XNLE
      DXE(5) = XNTE     - FLOAT(NBOX-1)
      DXE(6) = 0.0
      X = 0.5 * DX
      NB = 0
      KODE = 1
      DO 80 II=1,MB
   80 NXBX(II)=0
      NXBXCS=0
      DO 40 NP = 1,NBOX
      XN = FLOAT(NP) - 0.5
      YW = YN2
      IF (TWL .GT. 0.0) YW=AMIN1(YW,YN1+XN/(TWL/BETA))
      MB = IFIX(YW)+1
   28 MBP(NP) = MB
      IF(MB.GT.40) GO TO 15
      IF (NP .EQ. NBW) KODE =3
      IF (NSURF .EQ.1) GO TO 29
```

```
      IF (X .GT. X1) KODE =6
      IF (NP .EQ. NHW) KODE =3
      IF (X .GT. X3    ) KODE =4
      IF (X .GT. X3+DX) KODE=2
      IF (NP .EQ. NBOX) KODE =5
   29 IF(NB+MB.GT.2000) GO TO 15
      NBI(NP) = NB
      DO 40 MP = 1,MB
      IF (KODE .EQ. 1 .OR. KODE .EQ. 3) GO TO 70
      GO TO 71
   70 NXBX(MP)=NXBX(MP)+1
   71 CONTINUE
      IF (MP .NE. 1) GO TO 73
      IF (KODE .EQ. 2 .OR. KODE .EQ. 4 .OR. KODE .EQ. 5) GO TO 72
      GO TO 73
   72 NXBXCS=NXBXCS+1
   73 CONTINUE
      NB = NB + 1
      Y=DY*FLOAT(MP)-0.5*DY
   40 KBOX (NB    ) = KODE
      IF(KODE .EQ. 1 .OR. KODE .EQ. 3) NYBX(NP)=MP
   43 X=X+DX
      QORHO = 0.5*(AS*FM)**2
      FQ = -8.0*DX*DY*QORHO/FM*RHO
      RETURN
   50 CALL EXIT
      RETURN
      END
```

```
CPOUT       POUT
      SUBROUTINE POUT (IND)
      COMPLEX W,AIC
      COMPLEX VPIC,DS,PHIW,CK
      COMPLEX CZERO,PHI,PHITE,DPHI,SPHI
      DIMENSION SW(5,6),SURF(2,3),COD(7),C(50)
      COMMON/C1/KBOX(1000),XE(5),YE(3),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH
      COMMON/C3/VPIC(80,15),DS(2025),PHIW(50),CK(40),DXE(6),TPI,KF
      COMMON/C4/MOB(100),NBL(100),FO,IFR,XL,NS,NTM,NBW,NBT
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,MP,NB,NBOX,KODE,MODE
      COMMON/C6/CZERO,PHI,PHITE,DPHI,SPHI,RHO,NXCS,NYCS,NYBX(40)
      COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NXWING,NYWING
      COMMON/C9/W(45,45),AIC(45,45)
      DATA (SW(1,I),I=1,6)/26HMAP OF SONIC BOX OVERLAY   ,
     1                     26HON WING, TAIL AND WAKE     ,
     2                     26H         (S) - WING        ,
     3                     26H         ($) - TAIL        ,
     4                     26H         (.) - WAKE        ,
     5                     26H                           /
      DATA (SURF(1,I),I=1,3)/8HWING    ,8HTAIL    ,11HWING + TAIL /
      DATA COD/1HS,1H$,1HS,1H$,1HS,1H,,1H./
      GO TO (10,20,30,40), IND
   10 WRITE(6,11)  EM,AS,RHO,XE(1),XE(4),X1,X4,Y1,Y2,Y2,Y2,X2,X4,
     1AR(1),AR(2),NBW,NBT,NBS,NBS
   11 FORMAT(1H1///// 32X,42HHUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM
     1 ///37X,30HFLIGHT CONDITIONS AND GEOMETRY/1H0//15X, 13HMACH NUMBER
     2 =,F8.5,4X,16HSPEED OF SOUND =F10.3,4H L/T,4X,4HRHO=,F5.2 //1H0/
     854X,4HWING,18X,
     3 4HTAIL///22X,16HL.E. STATION (L),2F22.3//22X,16HROOT CHORD   (L),
     4 2F22.3// 22X,16HL.E. SPAN    (L),2F22.3//22X,16HT.E. SPAN    (L),
     5 2F22.3// 22X,16HTIP CHORD    (L),2F22.3//22X,16HTOTAL AREA (L*L),
     6 2F22.3// 22X,16HCHORDWISE BOXES ,I19,I22//
     7           22X,16HSPANWISE BOXES  ,I19,I22)
      WRITE(6,12)NBOX,DX,DY
   12 FORMAT(1H0/,11X,23HTOTAL CHORDWISE BOXES =,I3, 5X,11HBOX CHORD =,
     1 1P1E12.5,2H L, 5X,10HBOX SPAN =,1P1E12.5,2H L/    )
      WRITE (6,109)
  109 FORMAT (1H1,//// 31X,50HHUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM
     1(CONT-D)  ////)
      NB = 1
      DO 17 NP = 1,NBOX
      MB = MOB(NP)
      DO 13 MP = 1,MB
      K = KBOX(NB)
      C(MP) = COD(K)
   13 NB = NB + 1
      IF(NP.GT.6) GO TO 15
      WRITE(6,14)(SW(I,NP),I=1,5),(C(MP),MP=1,MB)
   14 FORMAT(10X,5A6,50A1)
      GO TO 17
   15 WRITE(6,16) (C(MP),MP=1,MB)
   16 FORMAT(40X,50A1)
   17 CONTINUE
      GO TO 1000
   20 NYS=NYWING
      NXS=NXWING
      DO 200 NS=1,2
      WRITE (6,201) (SURF(I,NS),I=1,2)
  201 FORMAT(1H1,30X,50HHUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT-
     1D) ///// 28X,43HAIC COLLOCATION STATION COORDINATES ON THE 2A6/1H0
```

```
     2,19X, 4HYAIC, 13X,13HXAIC VALUES--)
      DO 202 IY=1,NYS
      YC=YAIC(IY,NS)
  202 WRITE (6,203) YC,(XAIC(IX,IY,NS),IX=1,NXS)
      NYS=NYCS
      NXS=NXCS
      IF (NYS .EQ. 0 .OR. NXS .EQ. 0) GO TO  205
  200 CONTINUE
  205 RETURN
  203 FORMAT (1H0,12X,5E17.6/(1H ,29X,4E17.6))
   30 VEL=EM*AS
      Q=0.5*RHO*VEL**2
      RV=1.0/EKR
      BR=X1/2.0
      WRITE (6,220) FREQ(IFR),BR,EKR,RV,EM,VEL,RHO,Q
  220 FORMAT(1H1,30X ,50HHUGHES AIRCRAFT CO. TRANSONIC AIC PROGRAM (CONT
     1-D)////9X,28H OSCILLATORY FREQUENCY (CPS),4X,1PE12.5,/1H0,9X,15HRE
     2FERENCE CHORD,4X,1PE12.5,/1H0,9X,30HREDUCED FREQUENCY (REF. CHORD)
     3,4X,1PE12.5,/1H0,9X,29HREDUCED VELOCITY (REF. CHORD),4X,1PE12.5,
     4/1H0,9X,23HFREE STREAM MACH NUMBER,4X,1PE12.5,/1H0,9X,20HFREE STRE
     5AM VELOCITY,4X,1PE12.5,/1H0,9X,7HDENSITY,4X,0PF5.2,/1H0,9X,33HDYNA
     6MIC PRESSURE (1/2*RHO*VEL**2),4X,1PE12.5,////)
      WRITE (6,221)
  221 FORMAT(///35X,34HAERODYNAMIC INFLUENCE COEFFICIENTS,///X,2HRL,10X,
     12HIM,10X,2HRL,10X,2HIM,10X,2HRL,10X,2HIM,10X,2HRL,10X,2HIM,10X,2HR
     2L,10X,2HIM,/)
      NROWS=NYWING*NXWING+NYCS*NXCS
      DO 222 NROW=1,NROWS
      WRITE (6,223)NROW
      WRITE (6,224) (AIC(NROW,NCOL),NCOL=1,NROWS)
  223 FORMAT (/ 5HROW = I2)
  224 FORMAT (1P10F12.4)
  222 CONTINUE
      RETURN
   40 NW=NXWING*NYWING
      NC=NXCS*NYCS
      NT=NW+NC
      NW1=NW+1
      GO TO (81,82,83,84),LPUNCH
   81 CONTINUE
      DO 301 I=1,NW
      PUNCH 85, (AIC(I,J),J=1,NW)
  301 CONTINUE
   85 FORMAT (1P6E12.5)
      RETURN
   82 CONTINUE
      DO 302 I=NW1,NT
      PUNCH 85, (AIC(I,J),J=NW1,NT)
  302 CONTINUE
      RETURN
   83 CONTINUE
      DO 303 I=1,NW
      PUNCH 85, (AIC(I,J),J=1,NW)
  303 CONTINUE
      DO 304 I=NW1,NT
      PUNCH 85, (AIC(I,J),J=NW1,NT)
  304 CONTINUE
      RETURN
   84 CONTINUE
      DO 305 I=1,NT
```

```
      PUNCH 85, (ATC(I,J),J=1,NT)
  305 CONTINUE
 1000 RETURN
      END
```

```
CDAIN        DAIN
      SUBROUTINE DAIN
      COMPLEX VPIC,DS,PHIW,CK
      COMPLEX CZERO,PHI,PHITE,DPHI,SPHI
      COMMON/C1/KBOX(1000),XE(5),YE(3),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH
      COMMON/C3/VPIC(80,15),DS(2025),PHIW(50),CK(40),DXE(6),TPI,KF
      COMMON/C4/MOB(100),NBL(100),FQ,IFR,XL,NS,NTM,NBW,NBT
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,FKR,NP,MP,MB,NBOX,KODE,MODF
      COMMON/C6/CZERO,PHI,PHITE,DPHI,SPHI,RHO,NXCS,NYCS,NYBX(40)
      COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NXWING,NYWING
      READ(5,11) (XE(I),I=1,5)
      READ (5,11) (YE(I),I=1,3),AS
      READ (5,12) NMACH,KF,NFREQ,NBW,LPUNCH
      READ(5,11) (FMACH(I),I=1,NMACH)
      READ(5,11) (FREQ(I),I=1,NFREQ)
      NSURF=2
      IF(XE(4).LT.XE(5)) GO TO 10
      NSURF=1
      XE(4)=XE(3)
      XE(5)=XE(3)
   10 READ (5,12) NXWING,NYWING,NXCS,NYCS
      READ (5,11) (YAIC(I,1),I=1,NYWING)
      IF (NXCS .NE. 0) READ (5,11)(YAIC(I,2),I=1,NYCS)
      READ (5,11) ((XAIC(I,J,1),I=1,NXWING),J=1,NYWING)
      IF (NXCS .NE. 0) READ(5,11)((XAIC(I,J,2),I=1,NXCS),J=1,NYCS)
      NMODE=NXWING*NYWING+NXCS*NYCS
      RHO=1.0
   11 FORMAT(6E12.8)
   12 FORMAT(6I12)
      RETURN
      END
```

```
CCSTS         CSTS
      BLOCK DATA
      COMPLEX CZERO,PHI,PHITF,DPHI,SPHI
      COMPLEX VPIC,DS,PHIW,CK
      COMMON/C3/VPIC(80,15),DS(2025),PHIW(50),CK(40),DXE(6),TPI,KF
      COMMON/C6/CZERO,PHI,PHITE,DPHI,SPHI,RHO,NXCS,NYCS,NMAX(40)
      DATA CZERO/(0.0,0.0)/, TPI/6.2831853/
      END
```

```
CPOT2H      POT2H
      SUBROUTINE POT2H
      COMPLEX CZERO,PHI,PHITE,DPHI,SPHI
      COMPLEX VPIC,DS,PHIW,CK
      COMPLEX CEX
      COMMON/C1/KBOX(1010),XF(5),YF(5),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH
      COMMON/C3/VPIC(80,15),DS(2025),PHIW(50),CK(40),DXE(6),TPI,KF
      COMMON/C4/MOB(100),NBL(100),FQ,IFR,XL,NS,NTH,NBW,NRT
      COMMON/C5/X,Y,DX,DY,FM,EK,EKB,FKR,NP,MP,NB,NBOX,KODE,MODE
      COMMON/C6/CZERO,PHI,PHITE,DPHI,SPHI,RHO,NXCS,NYCS,NYBX(40)
      COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NXWING,NYWING
      M=2*MOB(NBOX)
      N=MIN0(NBOX,15)
      DK=FKB
      DK2=DK**2
      M1=M-1
      DK8=DK2/8.0
      DK4=2.0*DK8
      DK12=DK2/12.0
      CM=0.5
      DH=DK*0.5
      DM=1.5*DH
      DD=2.0*DK
      DDM=DD
      D1=0.25*DK2
      B5=DK2/24.0
      DO 23 I=1,M
      B1=0.0
      B4=2.0/DM
      B2=B5/B4-DH
      B3=-0.5*B5
      D3=DH*B4+B5
      D4=DK8*B4
      DD4=2.0*D4
      CN=1.0
      C3=0.0
      C4=0.0
      C7=0.0
      C8=0.0
      DO 23 J=1,N
      A1=DM/CN
      C1=CM* COS(A1)
      C2=-CM* SIN(A1)
      CALL CSIN(A1,C5,C6)
      C5=CM*C5
      C6=-CM*C6
      C9=C1-C3
      C10=C2-C4
      C11=C5-C7
      C12=C6-C8
      VRE=B3*C9-B4*C10-B5*C3-B1*C11-B2*C12
      VIM=B4*C9+B3*C10-B5*C4+B2*C11-B1*C12
      VPIC(I,J)=CMPLX(VRE,VIM)
   23 C3=C1
      C4=C2
      C7=C5
      C8=C6
      B1=B1-D1
      B3=B3-D3
      B4=B4-D4
```

```
      B4=B4+DB4
      CN=CN+2.0
    2 CONTINUE
      CM=CM+1.0
      DM=DM+DDM
    3 DDM=DDM+DD
      DO 5 J=1,N
      DO 4 I=1,M1
      K=M-I
    4 VPIC(K+1,J)=VPIC(K+1,J)-VPIC(K,J)
    5 VPIC(1,J)=2.0*VPIC(1,J)
      CM=0.0
      DM=0.0
      DDM=DK
      DO 12 I=1,M
      C7=0.0
      C8=0.0
      C9=0.0
      C10=0.0
      P1=0.0
      P2=0.0
      CN=1.0
      B6=0.5*DK12
      DO 10 J=1,N
      A1=CM/CN
      A2=DM/CN
      IF (A1-0.2) 7,7,8
    7 B1=2.0-A1**2/3.0
      B2=-DK/(6.0*CN)
      GO TO 9
    8 B3= SIN(A1)/A1
      B1=2.0*B3
      B2=(B3- COS(A1))/A2-DH/CN*B3
    9 B3= COS(A2)/CN
      B4= SIN(A2)/CN
      C3=B1*B3+B2*B4
      C4=B2*B3-B1*B4
      B5=DH*CN
      C1=B5*C4-2.0*C3
      C2=-2.0*C4-B5*C3
      C5=C1-C7
      C6=C2-C8
      P3=P2-B6*CN
      P4=P3+2.0*DK12*(CN-1.0)
      VRE=C5-P1*C6+P3*C3-P4*C9
      VIM=C6+P1*C5+P3*C1-P4*C10
    F VPIC(I,J)=VPIC(I,J)+CMPLX(VRE,VIM)
      P1=P1+DH
      P2=P2+CN*DK4
      CN=CN+2.0
      C7=C1
      C8=C2
      C9=C3
      C10=C4
      B6=B6+DK12
   10 CONTINUE
      CM=CM+DK
      DM=DM+DDM
   12 DDM=DDM+DD
      D3=DK/(2.0*3.14159265)
      A1=0.0
```

```
      DO 14  J=1,N
      CEX=DS*CMPLX(SIN(A1), COS(A1))
      DO 13  I=1,M
   13 VPIC(I,J)=CEX*VPIC(I,J)
   14 A1=A1+DH
      RETURN
      END
```

```
CPHIB        PHIB
      SUBROUTINE PHIB
      COMPLEX CZERO,PHI,PHITE,DPHI,SPHI
      COMPLEX VPIC,DS,PHIW,CK
      COMMON/C1/KHOX(1000),XF(5),YE(3),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH
      COMMON/C3/VPIC(80,15),DS(2025),PHIW(50),CK(40),DXE(6),TPI,KF
      COMMON/C4/MOB(100),NBL(100),FQ,IFR,XL,NS,NTM,NBW,NBT
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,FKR,NP,MP,NB,NROX,KODE,MODF
      COMMON/C6/CZERO,PHI,PHITE,DPHI,SPHI,RHO,NXCS,NYCS,NYBX(40)
      COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NXWING,NYWING
      NQ=MINO(NP,15)
      DO 20 I=2,NQ
      NU=NP-I+1
      JR=MOB(NU)
      NJ=NBL(NU)+1
      DO 20 J=1,JR
      K=1+IABS(MP-J)
      DPHI=VPIC(K,I)
      IF (J.EQ.1) GO TO 10
      K=MP+J-1
      DPHI=DPHI+VPIC(K,I)
   10 SPHI=SPHI+DPHI*DS(NJ)
   20 NJ=NJ+1
      RETURN
      END
```

```
CSD2        SD2
      SUBROUTINE SD2 (S,R,C,B,T,TR,TM)
      COMPLEX CZERO,PHI,PHITE,DPHI,SPHI
      COMPLEX VPIC,DS,PHIW,CK
      DIMENSION S(45,45),R(45,45),C(45,45),B(45,45),T(45,45),
     1          TR(45,45),TM(45,45)
      COMMON/C1/KBOX(1000),XF(5),YE(3),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH
      COMMON/C3/VPIC(80,15),DS(2025),PHIW(50),CK(40),DXE(6),TPI,KF
      COMMON/C4/MOB(100),NBL(100),FQ,IFR,XL,NS,NTM,NRW,NRT
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,FKR,NP,MP,NB,NBOX,KODE,MODE
      COMMON/C6/CZERO,PHI,PHITE,DPHI,SPHI,RHO,NXCS,NYCS,NYBX(40)
      COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NXWING,NYWING
C *** THIS SUBROUTINE GENERATES THE REAL PART OF THE SUBSTANTIAL
C *** DERIVATIVE MATRIX FOR THE VELOCITY POTENTIAL
      MB=MOB(NBOX)
      NM=0
      DO 10 I=1,MB
   10 NM=NM+NXBX(I)+NXBXCS
      DO 20 I=1,NM
      DO 20 J=1,NM
   20  TM(I,J)=0.0
      DO 100 I=1,MB
      IF (NXBX(I) .EQ. 0) GO TO 100
      NXS=NXBX(I)
      CALL BMAT (NXS,NRSB,NCSB,B)
      CALL TMAT (NXS,1,1,I,MSIZE,2,T,R)
      DO 101 MR=1,MSIZE
      DO 101 MC=1,NCSB
      TR(MR,MC)=0.0
      DO 101 MRC=1,MSIZE
  101 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*B(MRC,MC)
      CALL CMAT (NXS,I,2,1,NRSC,NCSC,2,C)
      DO 102 MR=1,NRSC
      DO 102 MC=1,NCSB
      T(MR,MC)=0.0
      DO 102 MRC=1,NCSC
  102 T(MR,MC)=T(MR,MC)+C(MR,MRC)*TR(MRC,MC)
      KROW=0
      DO 140 II=1,I
  140 KROW=KROW+NXBX(II)
      KROW=KROW-NXBX(I)
      DO 180 LR=1,NXS
      LROW=KROW+LR
      DO 180 LC=1,NXS
      LCOL=KROW+LC
  180 TM(LROW,LCOL)=T(LR,LC)
  100 CONTINUE
      IF (NXBXCS .LT. 2) GO TO 300
      DO 200 I=1,MB
      CALL BMAT (NXBXCS,NRSB,NCSB,B)
      CALL TMAT (NXBXCS,1,2,I,MSIZE,3,T,R)
      DO 201 MR=1,MSIZE
      DO 201 MC=1,NCSB
      TR(MR,MC)=0.0
      DO 201 MRC=1,MSIZE
  201 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*B(MRC,MC)
      CALL CMAT (NXBXCS,I,2,2,NRSC,NCSC,3,C)
      DO 202 MR=1,NRSC
      DO 202 MC=1,NCSB
      T(MR,MC)=0.0
```

```
      DO 202 MRC=1,NCSC
  202 T(MR,MC)=T(MR,MC)+C(MR,MRC)*TR(MRC,MC)
      KROW=0
      DO 203 IJ=1,MH
  203 KROW=KROW+NXBX(IJ)
      KROW=KROW+(I-1)*NXBXCS
      DO 200 LR=1,NXBXCS
      NROW=KROW+LR
      KCOL=KROW
      DO 208 LC=1,NXBXCS
      NCOL=KCOL+LC
  208 TM(NROW,NCOL)=T(LR,LC)
  200 CONTINUE
  300 CONTINUE
      RETURN
      END
```

```
CTRAMP
      SUBROUTINE TRAMP (NIF,MROWS,KCOLS,S,R,C,B,T,TR,TI,TM)
      COMPLEX CZERO,PHI,PHITE,DPHI,SPHI
      COMPLEX VPIC,DS,PHIW,CK
      DIMENSION S(45,45),R(45,45),C(45,45),B(45,45),T(45,45),TR(45,45),
     1          TI(45,45),TM(45,45)
      COMMON/C1/KBOX(1000),XF(5),YE(3),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH
      COMMON/C3/VPIC(80,15),DS(2025),PHIW(50),CK(40),DXE(6),TPI,KF
      COMMON/C4/MOB(100),NBL(100),FQ,IFR,XL,NS,NTM,NBW,NBT
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,FKR,NP,MP,NH,NBOX,KODE,MODF
      COMMON/C6/CZERO,PHI,PHITE,DPHI,SPHI,RHO,NXCS,NYCS,NYBX(40)
      COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NXWING,NYWING
      MB=MOB(NBOX)
      KCOLS=NXWING*NYWING+NXCS*NYCS
      KROWS=MB*(NXWING+NXCS)
C *** ZERO TM MATRIX FOR SPANWISE INTERPOLATION
      DO 20 I=1,KROWS
      DO 20 J=1,KCOLS
   20 TM(I,J)=0.0
C *** SPANWISE INTERPOLATION (WING)
      IF (NYWING .EQ. 0) GO TO 1999
      DO 1000 I=1,NXWING
      CALL BMAT (NYWING,NRSB,NCSB,B)
      CALL TMAT (NYWING,2,1,I,MSIZE,1,T,R)
      DO 1001 MR=1,MSIZE
      DO 1001 MC=1,NCSB
      TR(MR,MC)=0.0
      DO 1001 MRC=1,MSIZE
 1001 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*B(MRC,MC)
      CALL SMAT (MB,NYWING,1,NRSC,NCSC,S)
      DO 1002 MR=1,NRSC
      DO 1002 MC=1,NCSB
      T(MR,MC)=0.0
      DO 1002 MRC=1,NCSC
 1002 T(MR,MC)=T(MR,MC)+S(MR,MRC)*TR(MRC,MC)
      KROW=(I-1)*MB
      DO 1080 LR=1,MB
      LROW=KROW+LR
      KCOL=(I-1)*NYWING
      DO 1080 LC=1,NYWING
      LCOL=KCOL+LC
 1080 TM(LROW,LCOL)-T(LR,LC)
 1000 CONTINUE
 1999 CONTINUE
C *** SPANWISE TRANSFORMATION (CONTROL SURFACE)
      IF (NYCS .EQ. 0) GO TO 2999
      DO 2000 I=1,NXCS
      CALL BMAT (NYCS,NRSB,NCSB,B)
      CALL TMAT (NYCS,2,2,I,MSIZE,1,T,R)
      DO 2001 MR=1,MSIZE
      DO 2001 MC=1,NCSB
      TR(MR,MC)=0.0
      DO 2001 MRC=1,MSIZE
 2001 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*B(MRC,MC)
      CALL SMAT (MB,NYCS,2,NRSC,NCSC,S)
      DO 2002 MR=1,NRSC
      DO 2002 MC=1,NCSB
      T(MR,MC)=0.0
      DO 2002 MRC=1,NCSC
 2002 T(MR,MC)=T(MR,MC)+S(MR,MRC)*TR(MRC,MC)
```

```
      KROW=MB*NXWING+(I-1)*MB
      DO 2080 LR=1,MB
      LROW=KROW+LR
      KCOL=NXWING*NYWING+(I-1)*NYCS
      DO 2080 LC=1,NYCS
      LCOL=KCOL+LC
 2080 TM(LROW,LCOL)=T(LR,LC)
 2010 CONTINUE
 2999 CONTINUE
C *** REARRANGE ROWS AND COLUMNS FOR CHORDWISE TRANSFORMATION
      CALL RMAT (MB,NXWING,MB,NXCS,MSIZE,R)
      DO 2050 MR=1,MSIZE
      DO 2050 MC=1,KCOLS
      TI(MR,MC)=0.0
      DO 2050 MRC=1,KROWS
 2050 TI(MR,MC)=TI(MR,MC)+R(MR,MRC)*TM(MRC,MC)
C *** ZERO TM MATRIX FOR CHORDWISE INTERPOLATION
      MCOLS=MB*(NXWING+NXCS)
      MROWS=0
      DO 10 I=1,MB
   10 MROWS=MROWS+NXBX(I)+NXBXCS
      DO 60 I=1,MROWS
      DO 60 J=1,MCOLS
   60 TM(I,J)=0.0
C *** CHORDWISE INTERPOLATION (WING)
      IF (NXWING .EQ. 0) GO TO 3999
      DO 3000 I=1,MB
      CALL BMAT (NXWING,NRSB,NCSB,B)
      CALL TMAT (NXWING,1,1,I,MSIZE,1,T,R)
      DO 3001 MR=1,MSIZE
      DO 3001 MC=1,NCSB
      TR(MR,MC)=0.0
      DO 3001 MRC=1,MSIZE
 3001 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*B(MRC,MC)
      CALL CMAT (NXWING,I,NIF,1,NRSC,NCSC,1,C)
      DO 3002 MR=1,NRSC
      DO 3002 MC=1,NCSB
      T(MR,MC)=0.0
      DO 3002 MRC=1,NCSC
 3002 T(MR,MC)=T(MR,MC)+C(MR,MRC)*TR(MRC,MC)
      KROW=0
      DO 40 II=1,I
   40 KROW=KROW+NXBX(II)
      KROW=KROW-NXBX(I)
      JJ=NXBX(I)
      DO 3080 LR=1,JJ
      LROW=KROW+LR
      KCOL=(I-1)*NXWING
      DO 3080 LC=1,NXWING
      LCOL=KCOL+LC
 3080 TM(LROW,LCOL)=T(LR,LC)
 3000 CONTINUE
 3999 CONTINUE
C *** CHORDWISE INTERPOLATION (CONTROL SURFACE)
      IF (NXCS .EQ. 0) GO TO 4999
      DO 4000 I=1,MB
      CALL BMAT (NXCS,NRSB,NCSB,B)
      CALL TMAT (NXCS,1,2,I,MSIZE,1,T,R)
      DO 4001 MR=1,MSIZE
      DO 4001 MC=1,NCSB
      TR(MR,MC)=0.0
```

```
      DO 4001 MRC=1,MSIZE
4001  TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*R(MRC,MC)
      CALL CMAT (NXCS,I,NIF,2,NRSC,NCSC,1,C)
      DO 4002 MR=1,NRSC
      DO 4002 MC=1,NCSB
      T(MR,MC)=0.0
      DO 4002 MRC=1,NCSC
4002  T(MR,MC)=T(MR,MC)+C(MR,MRC)*TR(MRC,MC)
      KROW=LROW+(I-1)*NXBXCS
      DO 4080 LR=1,NXBXCS
      NROW=KROW+LR
      KCOL=MR*NXWING+(I-1)*NXCS
      DO 4080 LC=1,NXCS
      NCOL=KCOL+LC
4080  TM(NROW,NCOL)=T(LR,LC)
4000  CONTINUE
4999  CONTINUE
      DO 5001 MR=1,MROWS
      DO 5001 MC=1,KCOLS
      TR(MR,MC)=0.0
      DO 5001 MRC=1,MCOLS
5001  TR(MR,MC)=TR(MR,MC)+TM(MR,MRC)*TI(MRC,MC)
      CALL RMAT (NXWING,NYWING,NXCS,NYCS,MSIZE,R)
      DO 5050 I=1,MROWS
      DO 5050 J=1,MSIZE
      TI(I,J)=0.0
      DO 5050 K=1,MSIZE
5050  TI(I,J)=TI(I,J)+TR(I,K)*R(K,J)
      DO 5052 I=1,MROWS
      DO 5052 J=1,MSIZE
5052  TR(I,J)=TI(I,J)
      RETURN
      END
```

```
CCMAT
      SUBROUTINE CMAT (NAICPX,IY,NIF,NS,NRS,NCS,NE,C)
      COMPLEX CZERO,PHI,PHITE,DPHI,SPHI
      COMPLEX VPIC,DS,PHIW,CK
      DIMENSION C(45,45)
      COMMON/C1/KBOX(1000),XE(5),YE(5),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH
      COMMON/C3/VPIC(80,15),DS(2025),PHIW(50),CK(40),DXE(6),TPI,KF
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,FKR,NP,MP,NB,NBOX,KODE,MODE
      COMMON/C6/CZERO,PHI,PHITE,DPHI,SPHI,RHO,NXCS,NYCS,NYBX(40)
      COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NYWINO,NYWING
C *** FOR CHORDWISE INTERPOLATION
C *** NPTS = NUMBER OF CHORDWISE MACH BOXES
C *** NAICPX = NUMBER OF CHORDWISE AIC CONTROL POINTS
C *** IY = SPAN NUMBER
C *** NIF = CONTROL FOR DIFFERENTIATION  (1=NO DERIVATIVE AND 2=D()/DX)
C *** NS = SURFACE (1=WING AND 2=TAIL)
      IF (NAICPX .GT. 3) GO TO 3
      NRS=NXBX(IY)
      IF (NS .EQ. 2) NRS=NXBXCS
      NCS=NAICPX
      DO 1 I=1,NRS
      DO 1 J=1,NCS
    1 C(I,J)=0.0
      GO TO 100
    3 NRS=NXBX(IY)
      IF (NS .EQ. 2) NRS=NXBXCS
      NCS=3*(NAICPX-2)
      DO 4 I=1,NRS
      DO 4 J=1,NCS
    4 C(I,J)=0.0
  100 IF (NCS .GT. 6) GO TO 500
      IF (NCS .EQ. 6) GO TO 400
      GO TO (200,200,300),NCS
C *** TWO CHORDWISE AIC CONTROL POINTS
  200 DO 210 I=1,NRS
      C(I,1)=1.0
      C(I,2)=XBOX(I,IY,NS,NE)
      IF (NIF .EQ. 2) C(I,1)=0.0
      IF (NIF .EQ. 2) C(I,2)=1.0
  210 CONTINUE
      RETURN
C *** THREE CHORDWISE AIC CONTROL POINTS
  300 DO 310 I=1,NRS
      C(I,1)=1.0
      C(I,2)=XBOX(I,IY,NS,NE)
      C(I,3)=XBOX(I,IY,NS,NE)**2
      IF (NIF .EQ. 2) C(I,1)=0.0
      IF (NIF .EQ. 2) C(I,2)=1.0
      IF (NIF .EQ. 2) C(I,3)=2.0*XBOX(I,IY,NS,NE)
  310 CONTINUE
      RETURN
C *** FOUR CHORDWISE AIC CONTROL POINTS
  400 DO 410 I=1,NRS
      NX=NAICPX-1
      DO 406 J=1,NX
      IF (0.5*(XINT(J,IY,NS,NE)+XINT(J+1,IY,NS,NE)) .GT. XBOX(I,IY,NS,NE
     1)) GO TO 407
  406 CONTINUE
      NX=NAICPX
      GO TO 408
```

```
  407 NX=J
  406 KC=1
      IF (NX .GT. 2) KC=4
      C(I,KC)=1.0
      C(I,KC+1)=XBOX(I,IY,NS,NE)
      C(I,KC+2)=C(I,KC+1)**2
      IF (NIF .EQ. 2) C(I,KC)=0.0
      IF (NIF .EQ. 2) C(I,KC+1)=1.0
      IF (NIF .EQ. 2) C(I,KC+2)=2.0*XBOX(I,IY,NS,NE)
  410 CONTINUE
      RETURN
C *** .GT. FOUR AIC CONTROL POINTS
  500 DO 510 I=1,NRS
      NX=NAICPX-1
      DO 506 J=1,NX
      IF (0.5*(XINT(J,IY,NS,NE)+XINT(J+1,IY,NS,NE)) .GT. XBOX(I,IY,NS,NE
     1)) GO TO 507
  506 CONTINUE
      NX=NAICPX
      GO TO 508
  507 NX=J
  508 IF (NX .LT. 3) GO TO 550
      IF (NX .GT. NAICPX-2) GO TO 560
      KC=(NX-2)*3+1
      C(I,KC)=1.0
      C(I,KC+1)=XBOX(I,IY,NS,NE)
      C(I,KC+2)=C(I,KC+1)**2
      IF (NIF .EQ. 2) C(I,KC+1)=1.0
      IF (NIF .EQ. 2) C(I,KC+2)=XBOX(I,IY,NS,NE)
      IF (NIF .EQ. 2) C(I,KC)=0.0
      GO TO 510
  550 C(I,1)=1.0
      C(I,2)=XBOX(I,IY,NS,NE)
      C(I,3)=C(I,2)**2
      IF (NIF .EQ. 2) C(I,1)=0.0
      IF (NIF .EQ. 2) C(I,2)=1.0
      IF (NIF .EQ. 2) C(I,3)=XBOX(I,IY,NS,NE)
      GO TO 510
  560 C(I,NCS-2)=1.0
      C(I,NCS-1)=XBOX(I,IY,NS,NE)
      C(I,NCS)=C(I,NCS-1)**2
      IF (NIF .EQ. 2) C(I,NCS-2)=0.0
      IF (NIF .EQ. 2) C(I,NCS-1)=1.0
      IF (NIF .EQ. 2) C(I,NCS)=XBOX(I,IY,NS,NE)
  510 CONTINUE
      RETURN
      END
```

```
CTMAT   TMAT
      SUBROUTINE TMAT (NPTS,ND,NS,IY,MSIZE,NE,T,R)
      DIMENSION T(45,45),R(45,45)
      COMMON/CB/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NXWING,NYWING
C *** GENERATES (T)**(-1) MATRIX
C *** NPTS = NUMBER OF AIC POINTS ALONG STRIP IN ND DIRECTION
C *** MSIZE = ORDER OF  T  MATRIX
C *** NS = SURFACE  (1=WING AND 2=CONTROL SURFACE)
C *** ND = INTERPOLATION DIRECTION  (1=CHORDWISE AND 2=SPANWISE)
      IF (NPTS .LT. 4) MSIZE=NPTS
      IF (NPTS .GT. 3) MSIZE=3*NPTS-6
      DO 1 J=1,MSIZE
      DO 1 K=1,MSIZE
    1 T(J,K)=0.0
      IF (NPTS .GT. 4) GO TO 5000
      GO TO (2000,2000,3000,4000), NPTS
C *** NPTS=2  (TWO POINTS ALONG STRIP)
 2000 T(1,1)=1.0
      T(2,1)=1.0
      IF (ND .EQ. 1) T(1,2)=XINT(1,IY,NS,NE)
      IF (ND .EQ. 1) T(2,2)=XINT(2,IY,NS,NE)
      IF (ND .EQ. 2) T(1,2)=YAIC(1,NS)
      IF (ND .EQ. 2) T(2,2)=YAIC(2,NS)
      GO TO 6000
C *** NPTS=3  (THREE POINTS ALONG STRIP)
 3000 T(1,1)=1.0
      T(2,1)=1.0
      T(3,1)=1.0
      IF (ND .EQ. 2) GO TO 3010
C *** NPTS=3  CHORDWISE DIRECTION
      T(1,2)=XINT(1,IY,NS,NE)
      T(1,3)=T(1,2)**2
      T(2,2)=XINT(2,IY,NS,NE)
      T(2,3)=T(2,2)**2
      T(3,2)=XINT(3,IY,NS,NE)
      T(3,3)=T(3,2)**2
      GO TO 6000
C *** NPTS=3  SPANWISE DIRECTION
 3010 T(1,2)=YAIC(1,NS)
      T(1,3)=T(1,2)**2
      T(2,2)=YAIC(2,NS)
      T(2,3)=T(2,2)**2
      T(3,2)=YAIC(3,NS)
      T(3,3)=T(3,2)**2
      GO TO 6000
C *** NPTS=4  (FOUR POINTS ALONG STRIP)
 4000 T(1,1)=1.0
      T(2,1)=1.0
      T(3,1)=1.0
      T(4,2)=1.0
      T(5,4)=1.0
      T(6,4)=1.0
      T(3,4)=-1.0
      T(4,5)=-1.0
      IF (ND .EQ. 2) GO TO 4010
C *** NPTS=4  CHORDWISE DIRECTION
      T(1,2)=XINT(1,IY,NS,NE)
      T(1,3)=T(1,2)**2
      T(2,2)=XINT(2,IY,NS,NE)
      T(2,3)=T(2,2)**2
      T(3,2)=0.5*(XINT(2,IY,NS,NE)+XINT(3,IY,NS,NE))
```

```
      T(3,3)=T(3,2)**2
      T(3,5)=-T(3,2)
      T(3,6)=-T(3,3)
      T(4,3)=2.0*T(3,2)
      T(4,6)=-T(4,3)
      T(5,5)=XINT(3,IY,NS,NE)
      T(5,6)=T(5,5)**2
      T(6,5)=XINT(4,IY,NS,NE)
      T(6,6)=T(6,5)**2
      GO TO 6000
C *** NPTS=4  SPANWISE DIRECTION
 4010 T(1,2)=YAIC(1,NS)
      T(1,3)=T(1,2)**2
      T(2,2)=YAIC(2,NS)
      T(2,3)=T(2,2)**2
      T(3,2)=0.5*(YAIC(2,NS)+YAIC(3,NS))
      T(3,3)=T(3,2)**
      T(3,5)=-T(3,2)
      T(3,6)=-T(3,3)
      T(4,3)=2.0*T(3,2)
      T(4,6)=-T(4,3)
      T(5,5)=YAIC(3,NS)
      T(5,6)=T(5,5)**2
      T(6,5)=YAIC(4,NS)
      T(6,6)=T(6,5)**2
      GO TO 6000
C *** NPTS .GT. 4
 5000 IF (ND .EQ. 2) GO TO 5500
C *** NPTS .GT. 4  (CHORDWISE DIRECTION)
      T(1,1)=1.0
      T(1,2)=XINT(1,IY,NS,NE)
      T(1,3)=T(1,2)**2
      T(2,1)=1.0
      T(2,2)=XINT(2,IY,NS,NE)
      T(2,3)=T(2,2)**2
      T(MSIZE,MSIZE-2)=1.0
      T(MSIZE,MSIZE-1)=XINT(NPTS,IY,NS,NE)
      T(MSIZE,MSIZE)=T(MSIZE,MSIZE-1)**2
      T(MSIZE-1,MSIZE-2)=1.0
      T(MSIZE-1,MSIZE-1)=XINT(NPTS-1,IY,NS,NE)
      T(MSIZE-1,MSIZE)=T(MSIZE-1,MSIZE-1)**2
      NT=NPTS-4
      DO 5010 N=1,NT
      NR=2+3*N
      NC=3*N+1
      NP=N+2
      T(NR,NC)=1.0
      T(NR,NC+1)=XINT(NP,IY,NS,NE)
 5010 T(NR,NC+2)=T(NR,NC+1)**2
      NT=NPTS-3
      DO 5020 N=1,NT
      NR=3*N
      NC=3*N-2
      T(NR,NC)=1.0
      T(NR+1,NC+1)=1.0
      T(NR,NC+3)=-1.0
      T(NR+1,NC+4)=-1.0
      T(NR,NC+1)=0.5*(XINT(N+1,IY,NS,NE)+XINT(N+2,IY,NS,NE))
      T(NR,NC+2)=T(NR,NC+1)**2
      T(NR,NC+4)=-T(NR,NC+1)
      T(NR,NC+5)=-T(NR,NC+2)
```

```
      T(NR+1,NC+2)=2.0*T(NR,NC+1)
 5020 T(NR+1,NC+5)=-T(NR+1,NC+2)
      GO TO 6000
C *** NPTS .GT. 4  (SPANWISE DIRECTION)
 5500 T(1,1)=1.0
      T(1,2)=YAIC(1,NS)
      T(1,3)=T(1,2)**2
      T(2,1)=1.0
      T(2,2)=YAIC(2,NS)
      T(2,3)=T(2,2)**2
      T(MSIZE,MSIZE-2)=1.0
      T(MSIZE,MSIZE-1)=YAIC(NPTS,NS)
      T(MSIZE,MSIZE)=T(MSIZE,MSIZE-1)**2
      T(MSIZE-1,MSIZE-2)=1.0
      T(MSIZE-1,MSIZE-1)=YAIC(NPTS-1,NS)
      T(MSIZE-1,MSIZE)=T(MSIZE-1,MSIZE-1)**2
      NT=NPTS-4
      DO 5510 N=1,NT
      NR=2+3*N
      NC=3*N+1
      NP=N+2
      T(NR,NC)=1.0
      T(NR,NC+1)=YAIC(NP,NS)
 5510 T(NR,NC+2)=T(NR,NC+1)**2
      NT=NPTS-3
      DO 5520 N=1,NT
      NR=3*N
      NC=3*N-2
      T(NR,NC)=1.0
      T(NR+1,NC+1)=1.0
      T(NR,NC+3)=-1.0
      T(NR+1,NC+4)=-1.0
      T(NR,NC+1)=0.5*(YAIC(N+1,NS)+YAIC(N+2,NS))
      T(NR,NC+2)=T(NR,NC+1)**2
      T(NR,NC+4)=-T(NR,NC+1)
      T(NR,NC+5)=-T(NR,NC+2)
      T(NR+1,NC+2)=2.0*T(NR,NC+1)
 5520 T(NR+1,NC+5)=-T(NR+1,NC+2)
C *** INVERT  T  MATRIX
 6000 CONTINUE
      CALL MINV (MSIZE,T,R)
      RETURN
      END
```

```
CCSIN          CSIN
      SUBROUTINE CSIN(X1,U,S)
C     SINE AND COSINE INTEGRAL SUBROUTINE
C
C     C AND S ARE THE INTEGRALS OVER T FROM 1 TO INFINITY OF
C         COS(XT)/T  AND  SIN(XT)/T
C
      SG=1.0
      X=X1
      IF (X) 1,2,2
    1 SG=-SG
      X=-X
    2 X2=X*X
      IF (X-1.0) 3,3,4
C
C     FOR ABS(X) LESS THAN 1 A SERIES EXPANSION IS USED
C
    3 V=(((X2/98.0-0.6)*.05*X2+1.0)*X2/18.0-1.0)*X+1.5707963
      U=((X2/45.0-1.0)*X2/24.0+1.0)*X2/4.0-.577215665-ALOG(X)
      GO TO 5
C
C     FOR ABS(X) GREATER THAN 1 APPROXIMATIONS OF HASTINGS ARE USED
C
    4 P=(((X2+19.394119)*X2+47.411538)*X2+8.493336)/((((X2+21.361055)
     1   *X2+70.376496)*X2+30.038227)*X)
      Q=(((X2+21.383724)*X2+49.719775)*X2+5.089504)/((((X2+27.177958)
     1   *X2+119.918932)*X2+76.707876)*X2)
      CO=COS (X)
      SI=SIN (X)
      U=Q*CO-P*SI
      V=P*CO+Q*SI
    5 S=V*SG
      RETURN
      END
```

```
CMSIMEC     MSIMEC
      FUNCTION MSIMEC(M,N,L,A,B)
      COMPLEX A,B,G
      DIMENSION A(M,1),B(M,1)
      DO 30 I = 1,N
      C = 0.0
      DO 10 J = 1,N
   10 C=AMAX1(C,ABS(REAL(A(I,J))),ABS(AIMAG(A(I,J))))
      IF(C.EQ.0.0) GO TO 1000
      DO 20 J = 1,N
   20 A(I,J) = A(I,J)/C
      DO 30 J = 1,L
   30 B(I,J) = B(I,J)/C
      IF(N.EQ.1) GO TO 205
      NM = N - 1
      DO 200 J = 1,NM
      C = 0.0
      K = 0
      DO 40 I = J,N
      D=ABS(REAL(A(I,J)))+ABS(AIMAG(A(I,J)))
      IF(C.GE.D) GO TO 40
      K = I
      C = D
   40 CONTINUE
      IF(K.EQ.0.OR.C.LT.1.E-7) GO TO 1000
      IF(K.EQ.J) GO TO 70
      DO 50 JJ = J,N
      G=A(J,JJ)
      A(J,JJ) = A(K,JJ)
   50 A(K,JJ)=G
      DO 60 JJ = 1,L
      G=B(J,JJ)
      B(J,JJ) = B(K,JJ)
   60 B(K,JJ)=G
   70 G=1.0/A(J,J)
      JP = J + 1
      DO 80 JJ = JP,N
   80 A(J,JJ)=A(J,JJ)*G
   90 DO 100 JJ = 1,L
  100 B(J,JJ)=B(J,JJ)*G
      DO 200 I = 1,N
      IF(I.EQ.J) GO TO 200
      G=A(I,J)
      DO 110 JJ = JP,N
  110 A(I,JJ)=A(I,JJ)-G*A(J,JJ)
      DO 120 JJ = 1,L
  120 B(I,JJ)=B(I,JJ)-G*B(J,JJ)
  200 CONTINUE
  205 G=A(N,N)
      IF (ABS(REAL(G))+ABS(AIMAG(G)).LT.1.E-7) GO TO 1000
      DO 210 J = 1,L
  210 B(N,J)=B(N,J)/G
      IF(N.EQ.1) GO TO 230
      DO 220 I = 1,NM
      DO 220 JJ = 1,L
  220 B(I,JJ)=B(I,JJ)-A(I,N)*B(N,JJ)
  230 MSIMEC=1
      RETURN
 1000 MSIMEC=2
      RETURN
      END
```

```
CRMAT
      SUBROUTINE RMAT (NXWING,NYWING,NXCS,NYCS,MSIZE,R)
      DIMENSION R(45,45)
      MSIZE=NXWING*NYWING+NXCS*NYCS
      DO 100 I=1,MSIZE
      DO 100 J=1,MSIZE
  100 R(I,J)=0.0
      IF (NXWING .EQ. 0) GO TO 250
      K=1
      KK=1
      II=NYWING*NXWING
      DO 200 I=1,II
      R(I,K)=1.0
      K=K+NXWING
      IF (K .GT. II) KK=KK+1
      IF (K .GT. II) K=KK
  200 CONTINUE
  250 CONTINUE
      IF (NXCS .EQ. 0) GO TO 350
      II=NXCS*NYWING
      K=NXWING*NYWING+1
      KK=NXWING*NYWING+1
      DO 300 I=1,II
      IK=I+NXWING*NYWING
      R(IK,K)=1.0
      K=K+NXCS
      IF (K .GT. MSIZE) KK=KK+1
      IF (K .GT. MSIZE) K=KK
  300 CONTINUE
  350 CONTINUE
      RETURN
      END
```

```
CXINT
      FUNCTION XINT(NX,NY,NS,NE)
      COMMON/C1/KBOX(1000),XF(5),YF(3),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,MP,NB,NBOX,KODE,MODE
      COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBACS,NXWING,NYWING
      IF (NE .GT. 1) GO TO 400
      IF (NS .EQ. 1) GO TO 200
      XINT=XAIC(NX,1,NS)
      RETURN
  200 IF (FLOAT(NY)*DY-DY .GE. YF(2)) GO TO 300
      XINT=XAIC(NX,1,NS)
      RETURN
  300 IF (YAIC(1,1) .LE. YE(2))
     1SLOPE=(YAIC(NYWING,1)-YE(2))/(XAIC(NX,NYWING,1)-XAIC(NX,1,1))
      IF (YAIC(1,1) .GT. YF(2))
     1SLOPE=(YAIC(NYWING,1)-YAIC(1,1))/(XAIC(NX,NYWING,1)-XAIC(NX,1,1))
      IF (YAIC(1,1) .LE. YF(2))
     1XINT=(DY*FLOAT(NY)-DY-YE(2)+YE(1))/SLOPE + XAIC(NX,1,1)
      IF (YAIC(1,1) .GT. YE(2))
     1XINT=(DY*FLOAT(NY)-DY-YAIC(1,1)+YE(1))/SLOPE + XAIC(NX,1,1)
      RETURN
  400 XINT=DX*(FLOAT(NX)-0.5)
      RETURN
      END
```

```
CXBOX
      FUNCTION XBOX(NX,NY,NS,NE)
      COMMON/C1/KBOX(1000),XE(5),YE(5),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C5/X,Y,DX,DY,EM,EK,EKR,EKR,NP,MP,NB,NBOX,KODE,MODE
      COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NXWING,NYWING
      IF (NE .GT. 1) GO TO 100
      IF (NS .EQ. 2) GO TO 200
      XBOX=DX*(FLOAT(NXBX(1))-FLOAT(NXBX(NY)))+DX*FLOAT(NX)-0.5*DX
      RETURN
  200 XBOX=XE(4)+DX*(FLOAT(NX)-0.5)
      RETURN
  300 XBOX=DX*(FLOAT(NX)-0.5)
      RETURN
      END
```

```
CYBOX
      FUNCTION YBOX(NY)
      COMMON/C5/X,Y,DX,DY,EM,EK,EKR,EKR,NP,MP,NB,NBOX,KODE,MODE
      YBOX=DY*(FLOAT(NY)-1.0)
      RETURN
      END
```

```
C BMAT
      SUBROUTINE BMAT (NPTS,IROWS,ICOLS,B)
      DIMENSION B(4[illegible],45)
C *** B = B(IROWS,ICOLS)  MATRIX
C *** NPTS = NUMBER OF AIC STATIONS ALONG STRIP (CHORDWISE OR SPANWISE)
      ICOLS=NPTS
      IF (NPTS .GT. 3) GO TO 200
      IROWS=NPTS
      DO 50 I=1,IROWS
      DO 50 J=1,ICOLS
      B(I,J)=0.0
      IF (I .EQ. J) B(I,J)=1.0
   50 CONTINUE
      RETURN
  200 IROWS=6+(NPTS-4)*[illegible]
      DO 300 I=1,IROWS
      DO 300 J=1,ICOLS
  300 B(I,J)=0.0
      B(1,1)=1.0
      B(2,2)=1.0
      B(IROWS,ICOLS)=1.0
      B(IROWS-1,ICOLS-1)=1.0
      IF (NPTS .EQ. 4) GO TO 400
      K=NPTS-4
      DO [illegible] I=1,K
      NR=[illegible]*I
      NC=[illegible]I
  3[illegible]0 B(NR,NC)=1.0
  400 RETURN
      END
```

```
CSMAT
      SUBROUTINE SMAT (NIY,NAICPY,NS,NRS,NCS,S)
      DIMENSION S(45,45)
      COMMON/C1/KBOX(1000),XE(5),YE(3),AR(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C8/XAIC(10,10,2),YAIC(10,2),NXBX(40),NXBXCS,NYWING,NYWING
C *** NIY = NUMBER OF SPANWISE MACH BOXES
C *** NAICPY = NUMBER OF SPANWISE AIC CONTROL POINTS
C *** NS = SURFACE (1=WING AND 2=TAIL)
C *** NRS = NUMBER OF ROWS IN S-MATRIX
C *** NCS = NUMBER OF COLUMNS IN S-MATRIX
C     COMMON
      IF (NAICPY .GT. 3) GO TO 8
      NRS=NIY
      NCS=NAICPY
      DO 6 I=1,NRS
      DO 6 J=1,NCS
    6 S(I,J)=0.0
      GO TO 100
    8 NRS=NIY
      NCS=3*(NAICPY-2)
      DO 9 I=1,NRS
      DO 9 J=1,NCS
    9 S(I,J)=0.0
  100 IF (NCS .GT. 6) GO TO 500
      IF (NCS .EQ. 6) GO TO 400
      GO TO (200,200,300),NCS
C *** TWO AIC POINTS
  200 DO 260 I=1,NIY
      S(I,1)=1.0
      S(I,2)=YBOX(I)
  260 CONTINUE
      RETURN
C *** THREE AIC POINTS
  300 DO 360 I=1,NIY
      S(I,1)=1.0
      S(I,2)=YBOX(I)
      S(I,3)=S(I,2)**2
  360 CONTINUE
      RETURN
C *** FOUR AIC POINTS
  400 DO 490 I=1,NIY
      IC=4
      IF (YBOX(I) .LT. 0.5*(YAIC(2,NS)+YAIC(3,NS))) IC=1
      S(I,IC)=1.0
      S(I,IC+1)=YBOX(I)
      S(I,IC+2)=S(I,IC+1)**2
  490 CONTINUE
      RETURN
C *** .GT. FOUR AIC POINTS
  500 DO 520 I=1,NIY
      NI=NAICPY-2
      DO 525 J=1,NI
      IF(0.5*(YAIC(J,NS)+YAIC(J+1,NS)) .GT. YBOX(I)) GO TO 523
  525 CONTINUE
      IC=3*NAICPY-8
      GO TO 524
  523 IC=(J-2)*3+4
      IF (J .LT. 3) IC=1
  524 S(I,IC)=1.0
      S(I,IC+1)=YBOX(I)
```

```
      S(I,IC+2)=S(I,IC+1)**2
  520 CONTINUE
      RETURN
      END
```

```
CMINV     MINV
      SUBROUTINE MINV (NM,A,U)
      DIMENSION A(45,45),U(45,45)
      DO 9001 I=1,NM
      DO 9001 J=1,NM
      U(I,J)=0.0
      IF (I.EQ.J) U(I,J)=1.0
 9001 CONTINUE
      EPS=0.0000001
      DO 9015 I=1,NM
      K=I
      IF (I-NM) 9021,9007,9021
 9021 IF (A(I,I)-EPS) 9005,9006,9007
 9005 IF (-A(I,I)-EPS) 9006,9006,9007
 9006 K=K+1
      DO 9023 J=1,NM
      U(I,J)=U(I,J)+U(K,J)
 9023 A(I,J)=A(I,J)+A(K,J)
      GO TO 9021
 9007 DIV=A(I,I)
      DO 9009 J=1,NM
      U(I,J)=U(I,J)/DIV
 9009 A(I,J)=A(I,J)/DIV
      DO 9015 MM=1,NM
      DELT=A(MM,I)
      IF (ABS(DELT)-EPS) 9015,9015,9016
 9016 IF (MM-I) 9010,9015,9010
 9010 DO 9011 J=1,NM
      U(MM,J)=U(MM,J)-U(I,J)*DELT
 9011 A(MM,J)=A(MM,J)-A(I,J)*DELT
 9015 CONTINUE
      DO 9033 I=1,NM
      DO 9033 J=1,NM
 9033 A(I,J)=U(I,J)
      RETURN
      END
```

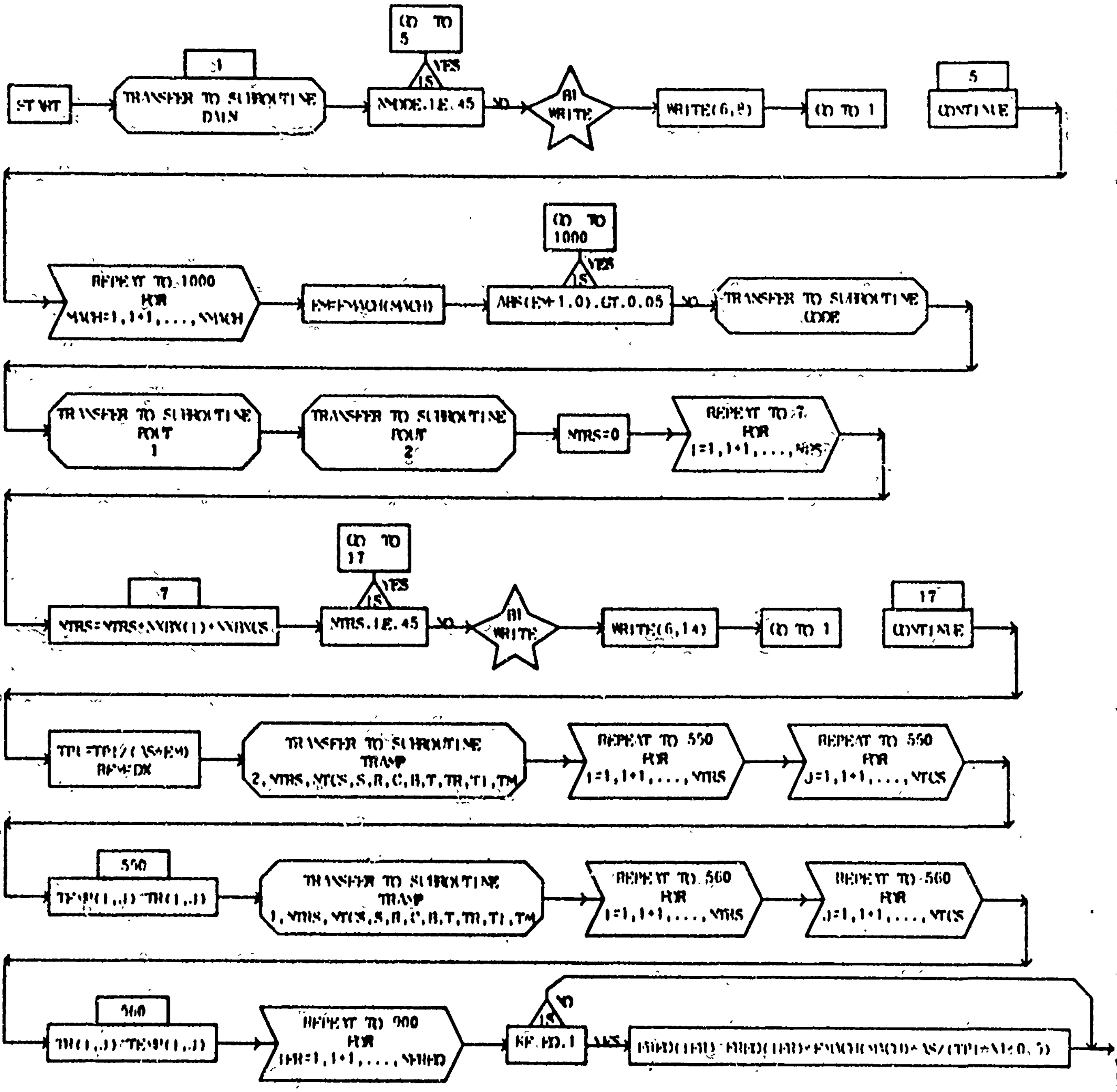
PART V - SECTION B5.0

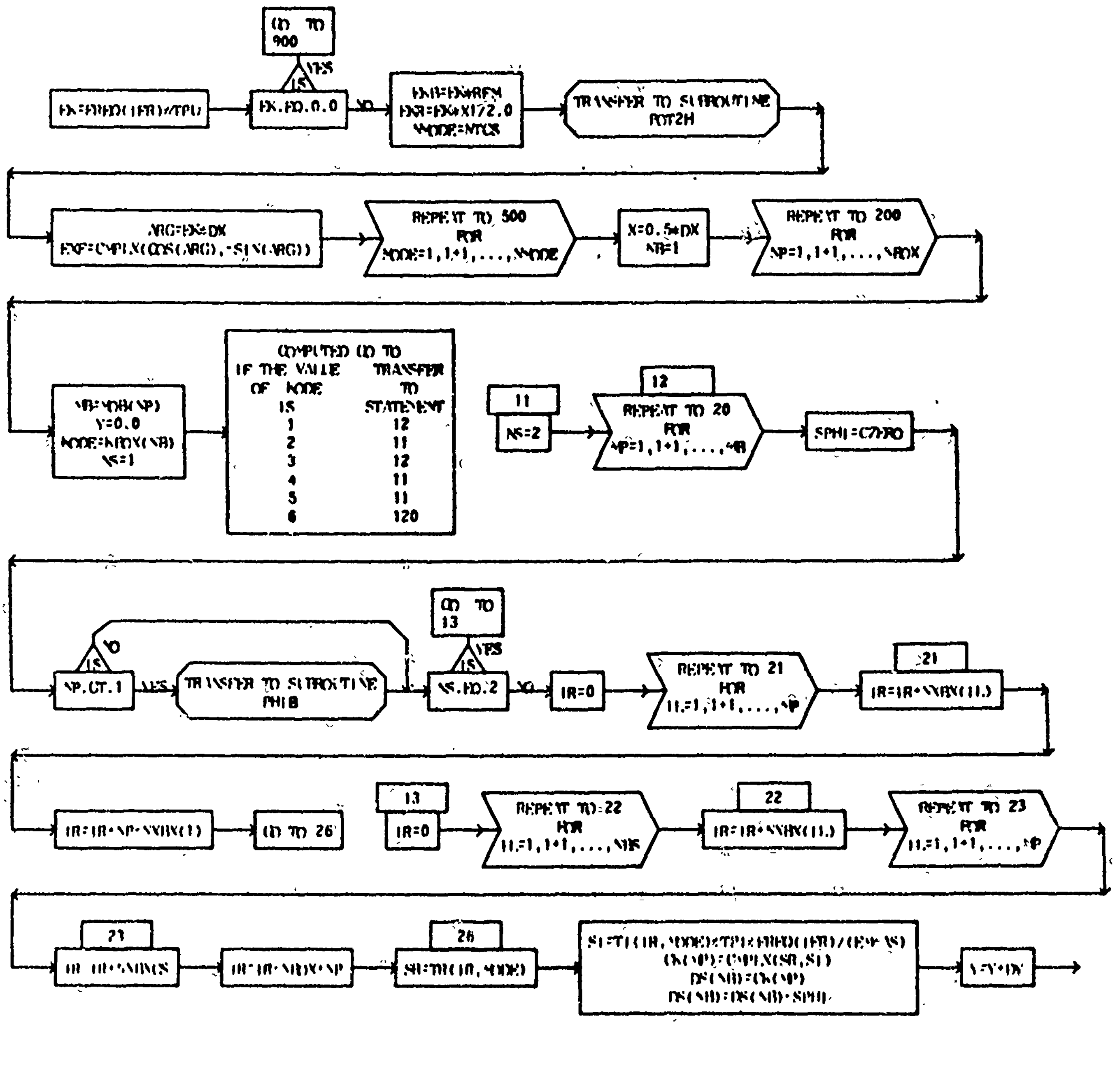
FLOW CHARTS FOR TRANSONIC

AIC COMPUTER PROGRAM

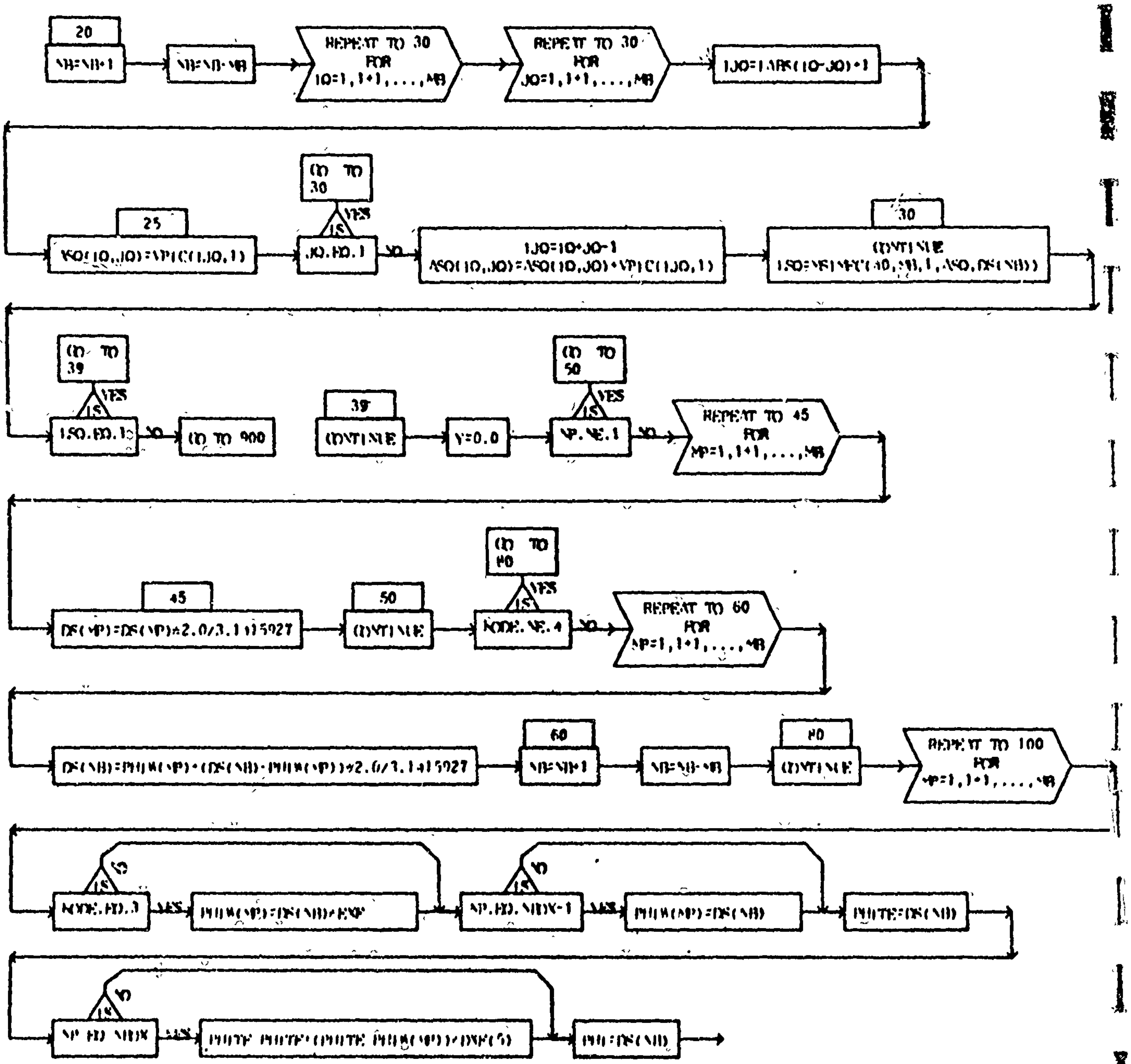
D I M E N S I O N E D   V A R I A B L E S

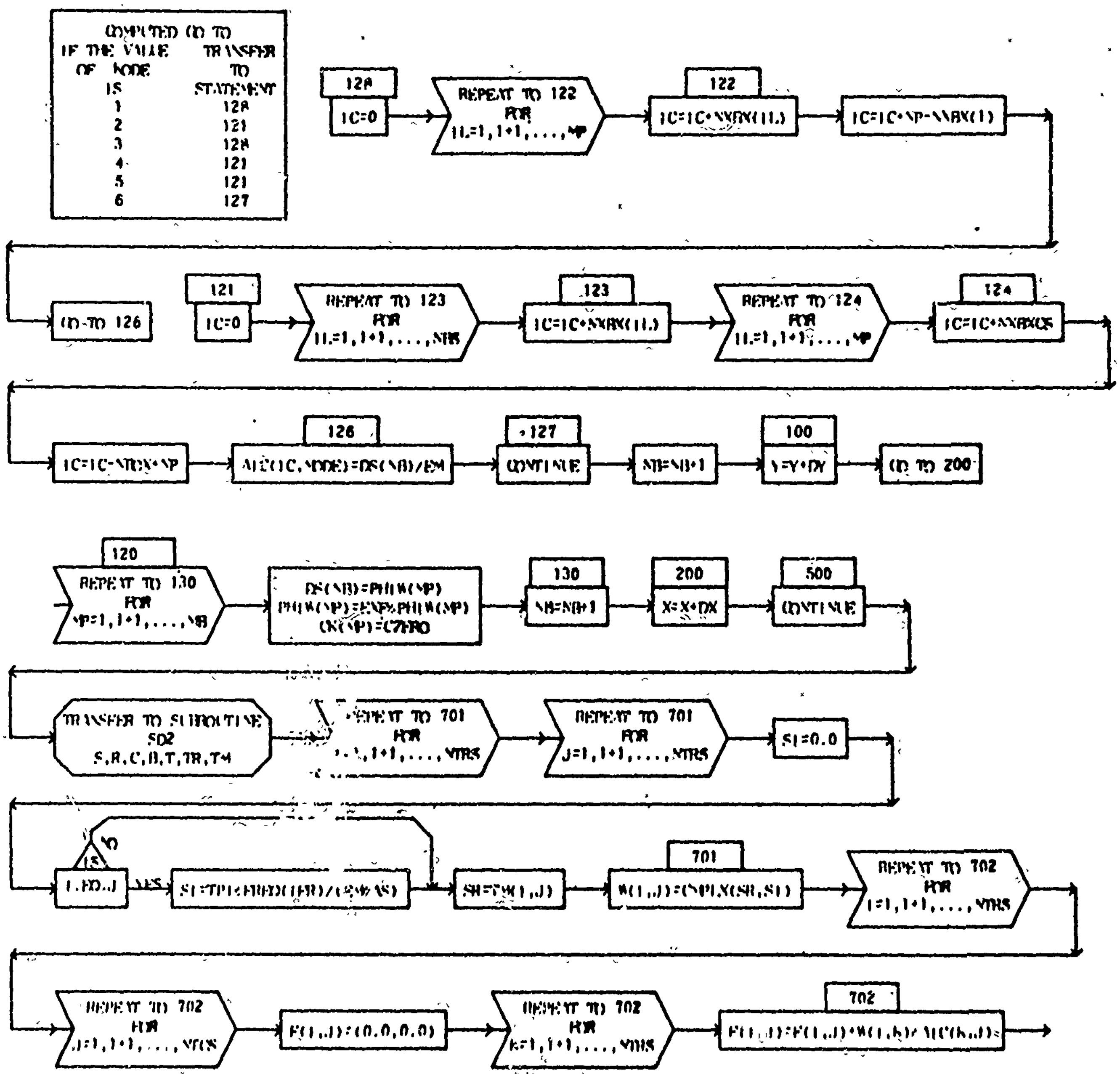
SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE
VO	40,40	F	45,45	S	45,45	R	45,45	C	45,45
R	45,45	T	45,45	TEMP	45,45	TM	45,45	TI	45,45
TR									

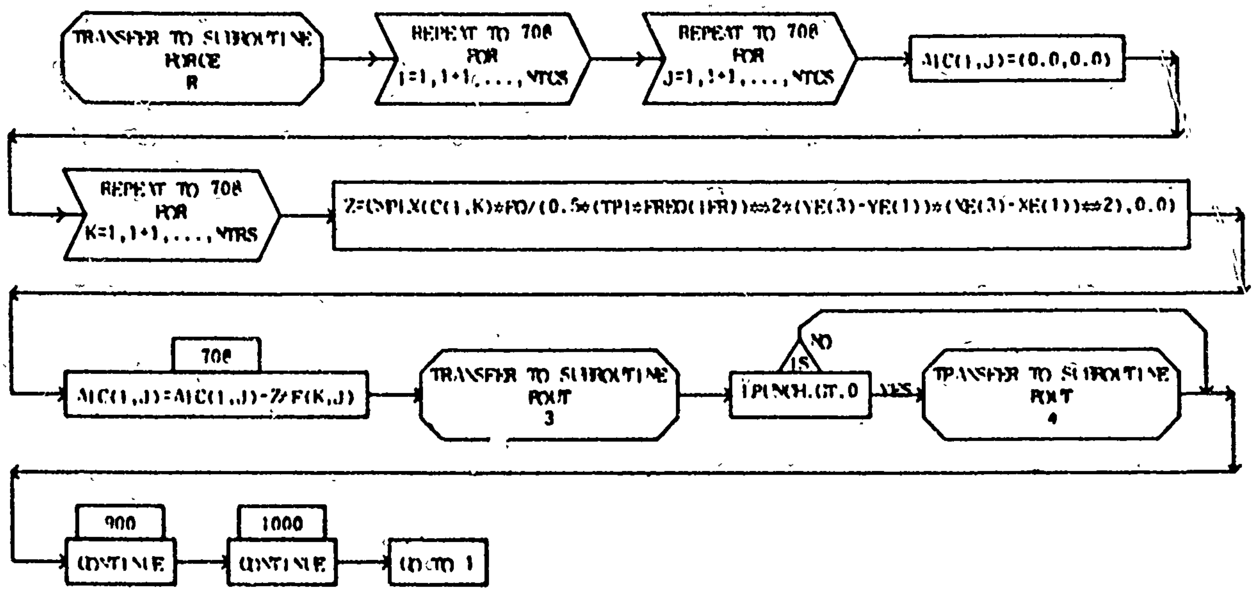



GO TO 900
YES
IS
FX.EQ.0.0
NO
TRANSFER TO SUBROUTINE POT2H
ARG=FX*DX
REPEAT TO 500 FOR
X=0.5*DX
NB=1
REPEAT TO 200 FOR
Y=0.0
NS=1
COMPUTED GO TO
IF THE VALUE OF MODE IS
TRANSFER TO STATEMENT
1 12
2 11
3 12
4 11
5 11
6 120
11
NS=2
12
REPEAT TO 20 FOR
SPHI=CZERO
GO TO 13
NO
YES
NP.GT.1
TRANSFER TO SUBROUTINE PHIB
NS.EQ.2
IR=0
REPEAT TO 21 FOR
21
GO TO 26
13
IR=0
REPEAT TO 22 FOR
22
REPEAT TO 23 FOR
23
26

NOT REPRODUCIBLE



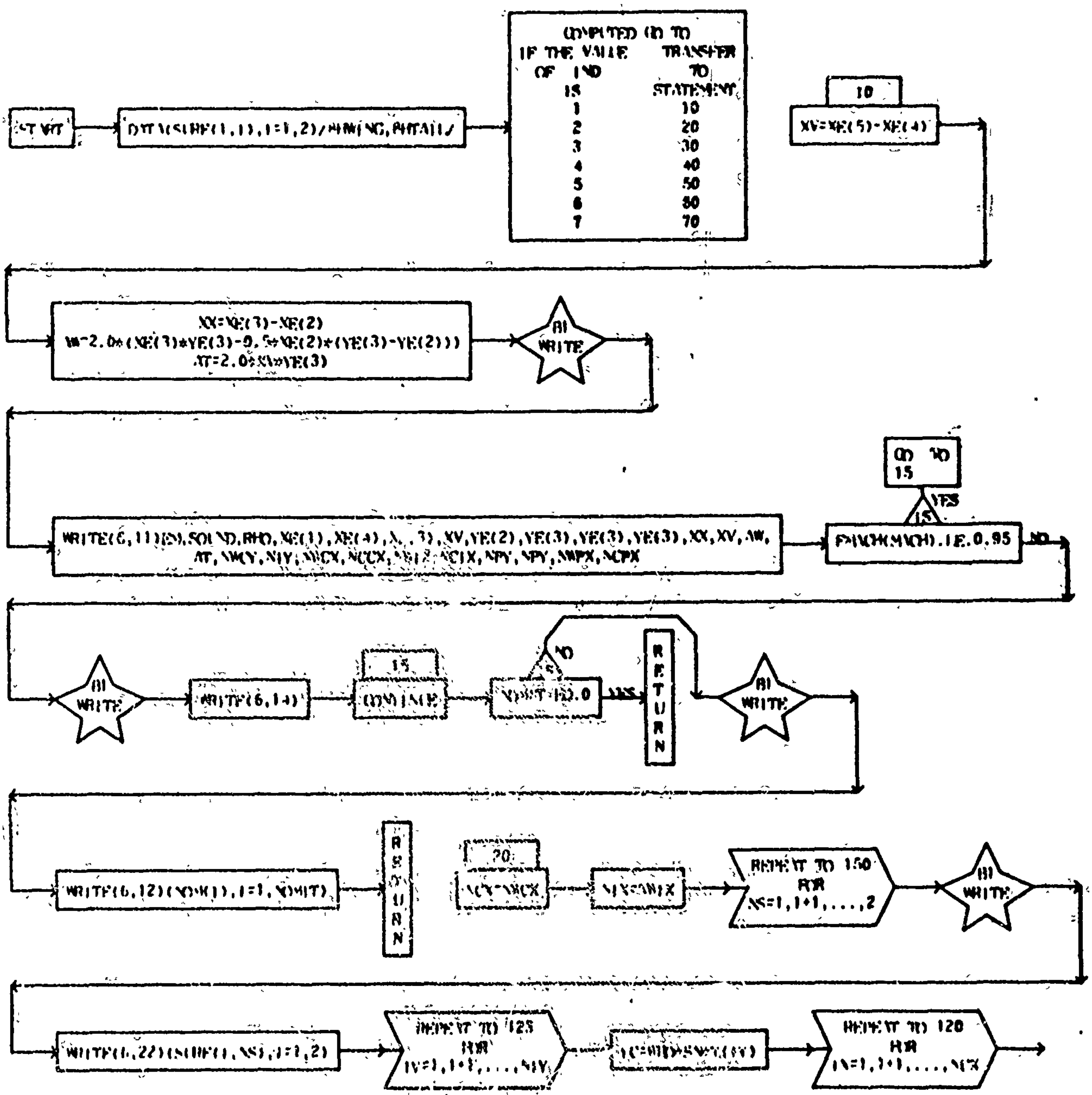

COMPUTED GO TO
IF THE VALUE OF NODE IS 1 TRANSFER TO STATEMENT 128
2 121
3 128
4 121
5 121
6 127
128
IC=0
REPEAT TO 122 FOR IL=1,1+1,...,MP
122
IC=IC+NNBX(IL)
IC=IC+NP-NNBX(I)
GO TO 126
121
IC=0
REPEAT TO 123 FOR IL=1,1+1,...,NB
123
IC=IC+NNBX(IL)
REPEAT TO 124 FOR IL=1,1+1,...,MP
124
IC=IC+NNBXCS
IC=IC-NTOS+NP
126
CONTINUE
NB=NB+1
100
Y=Y+DY
GO TO 200
120
REPEAT TO 130 FOR MP=1,1+1,...,NB
DS(NB)=PHIW(NP)
CK(NP)=CZERO
130
NB=NB+1
200
X=X+DX
500
CONTINUE
TRANSFER TO SUBROUTINE SD2 S,R,C,B,T,TR,TM
REPEAT TO 701 FOR
REPEAT TO 701 FOR J=1,1+1,...,NTRS
SI=0.0
701
NO
YES
SR=T(I,J)
W(I,J)=CMPLX(SR,SI)
REPEAT TO 702 FOR I=1,1+1,...,NTRS
REPEAT TO 702 FOR J=1,1+1,...,NTRS
F(I,J)=(0.0,0.0)
REPEAT TO 702 FOR K=1,1+1,...,NTRS
702


TRANSFER TO SUBROUTINE FORCE R
REPEAT TO 708 FOR I=1,1+1,...,NTCS
REPEAT TO 708 FOR J=1,1+1,...,NTCS
AIC(I,J)=(0.0,0.0)
REPEAT TO 708 FOR K=1,1+1,...,NTRS
Z=CMPLX(C(I,K)*FO/(0.5*(TPI*FREQ(IFR))**2*(YE(3)-YE(1))*(XE(3)-XE(1))**2),0.0)
708
AIC(I,J)=AIC(I,J)-Z*F(K,J)
TRANSFER TO SUBROUTINE POUT 3
IS
IPUNCH.GT.0
NO
YES
TRANSFER TO SUBROUTINE POUT 4
900
CONTINUE
1000
CONTINUE
GO TO 1

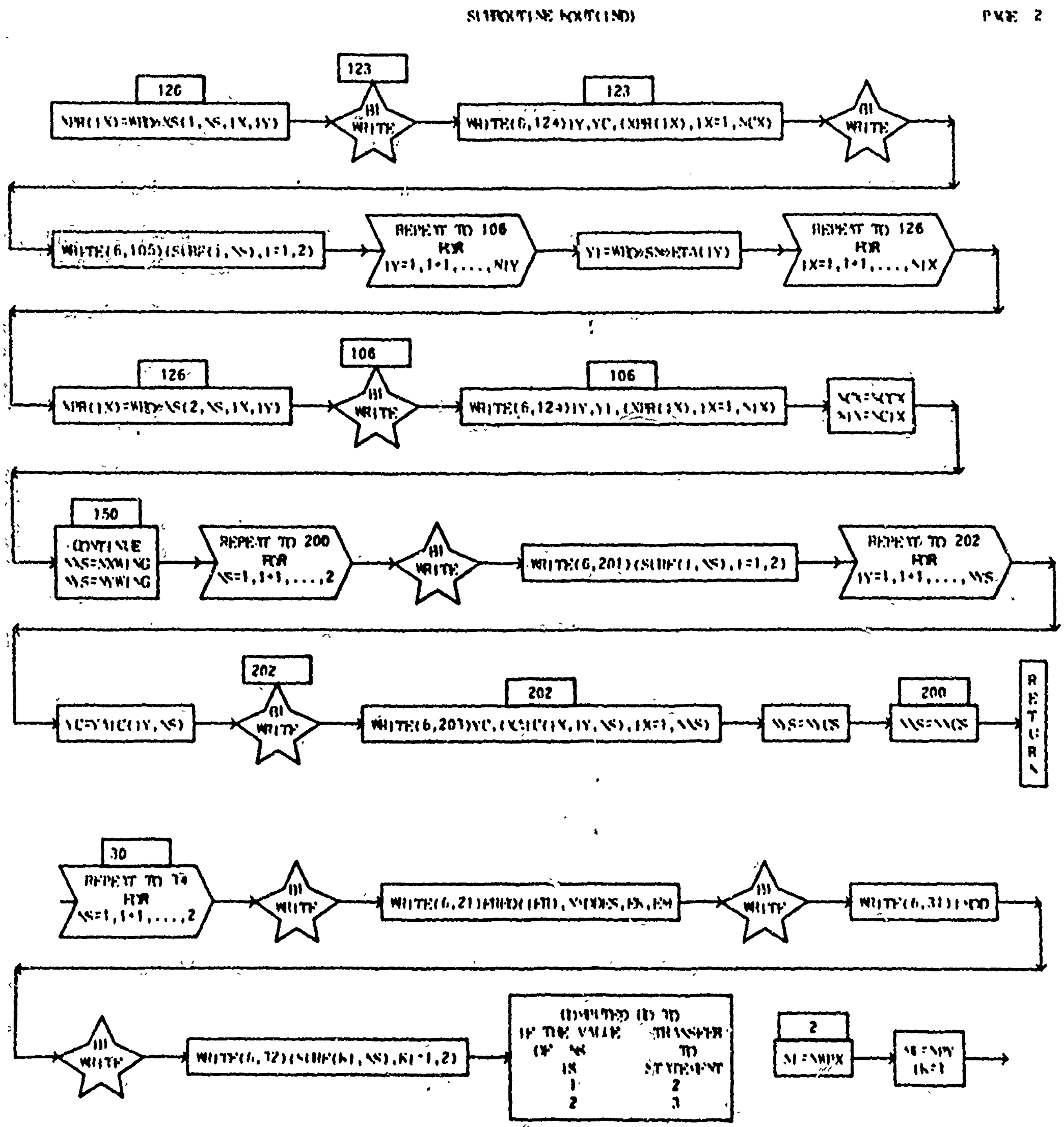
NXT NXT

DIMENSIONED VARIABLES

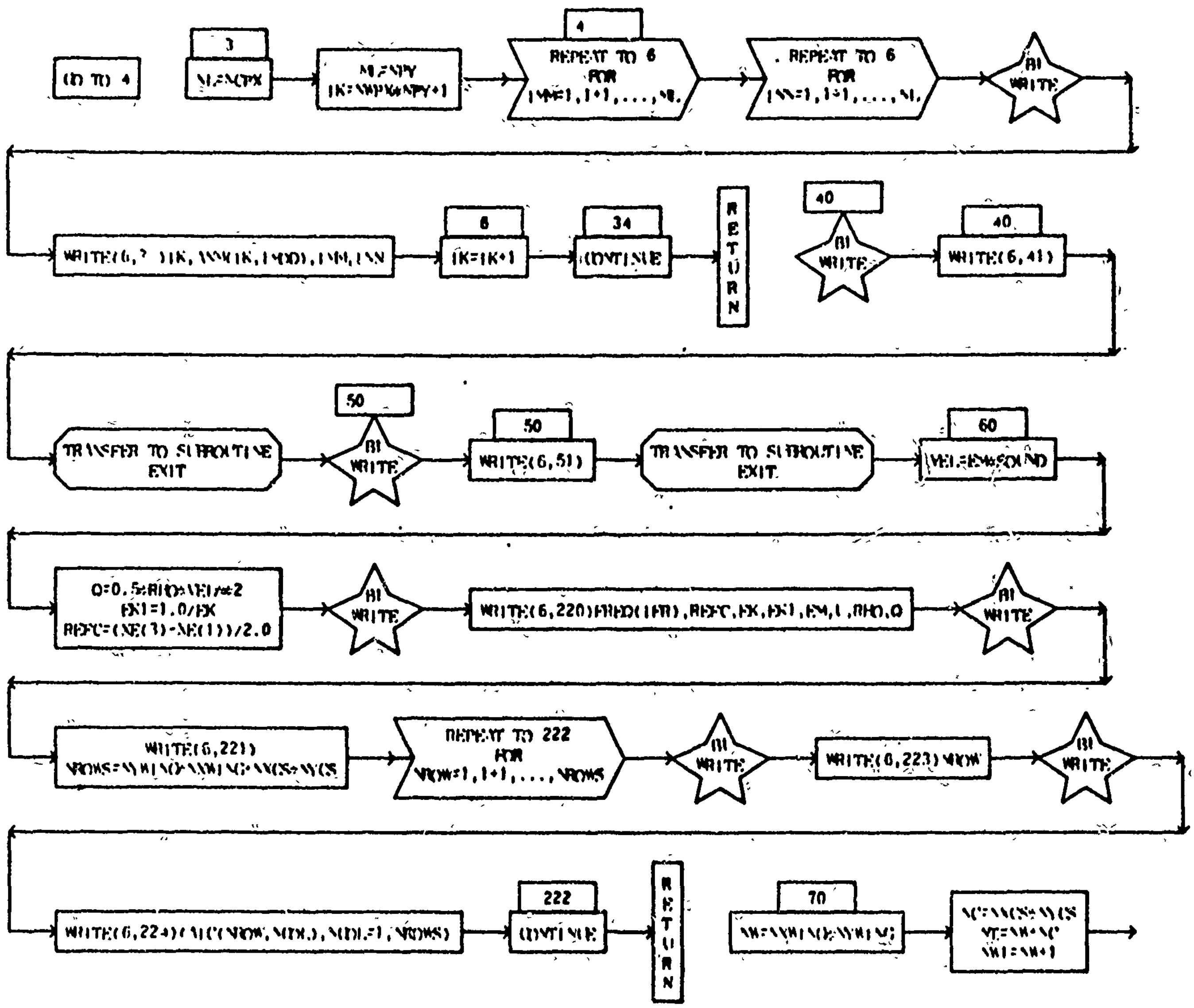
SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
SURF	2,2	NPR	50	MC	40,80	WASH	40		


START
COMPUTED GO TO
IF THE VALUE OF IND IS
TRANSFER TO STATEMENT
1 10
2 20
3 30
4 40
5 50
6 60
7 70
10
XV=XE(5)-XE(4)
WRITE
WRITE(6,14)
15
CONTINUE
RETURN
WRITE
YES
NO
15
70
REPEAT TO 150 FOR
WRITE
REPEAT TO 125 FOR
REPEAT TO 120 FOR

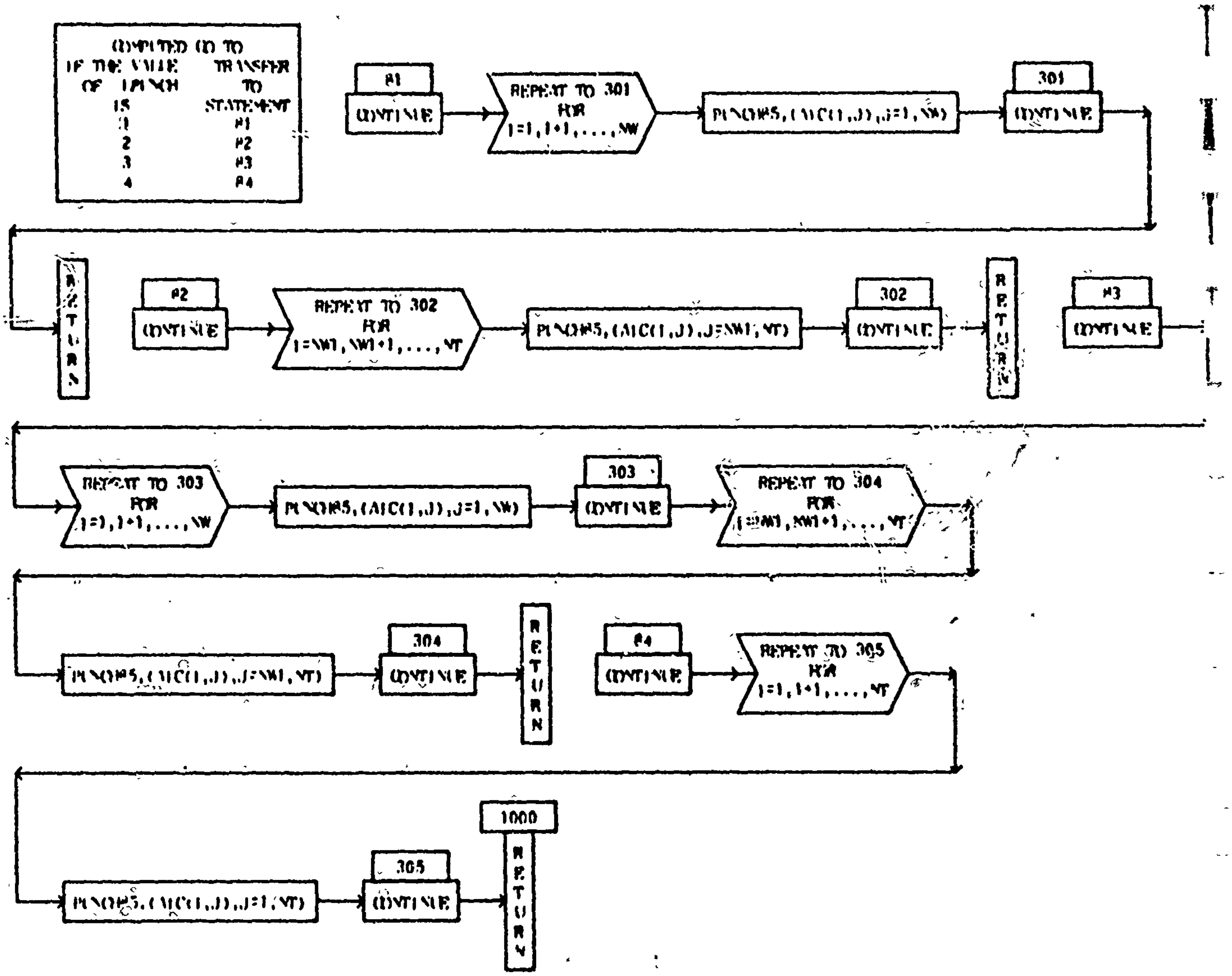
NOT REPRODUCIBLE



NOT REPRODUCIBLE



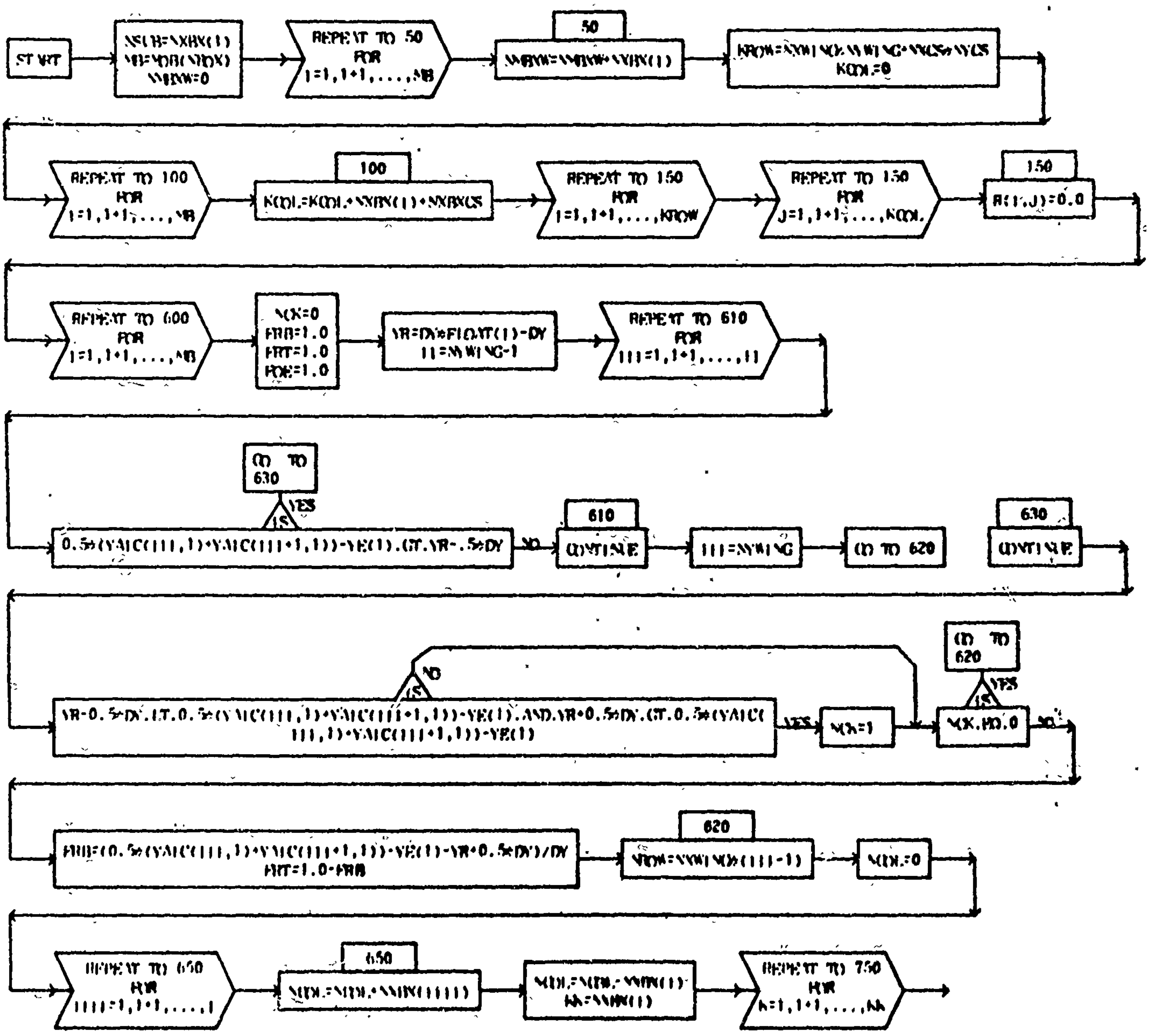
SUBROUTINE KOUT(IND)

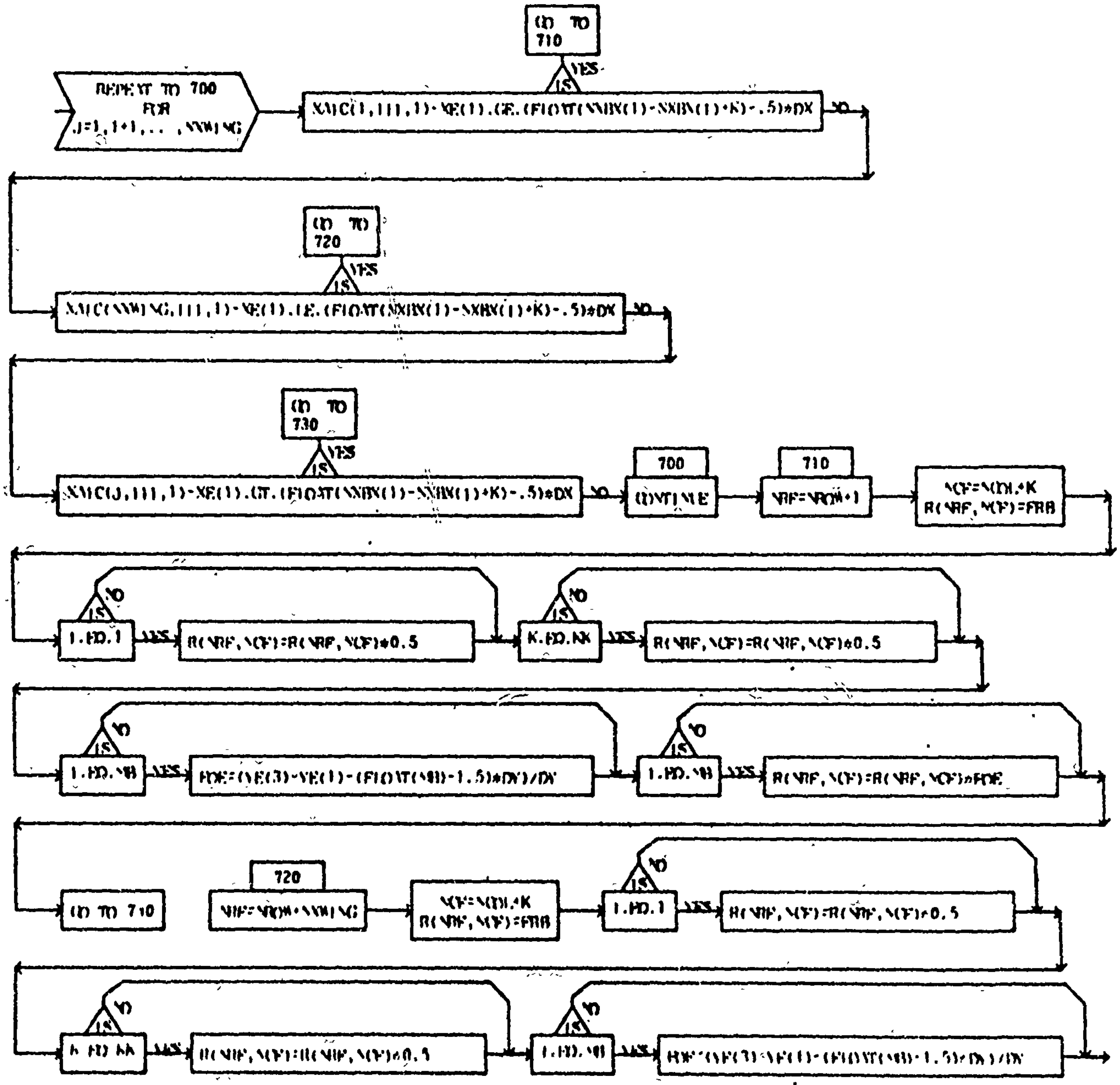


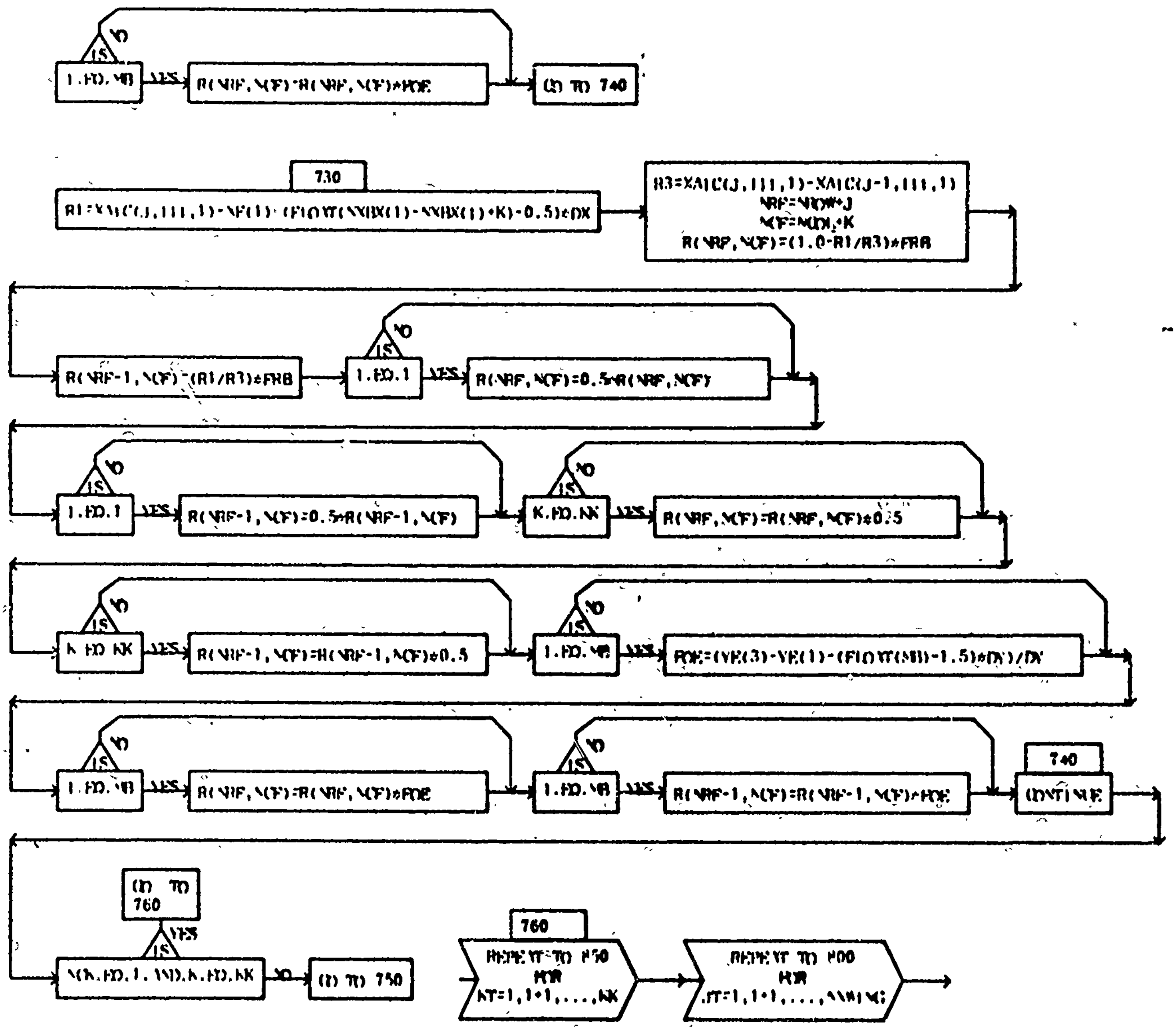
HACE HACE

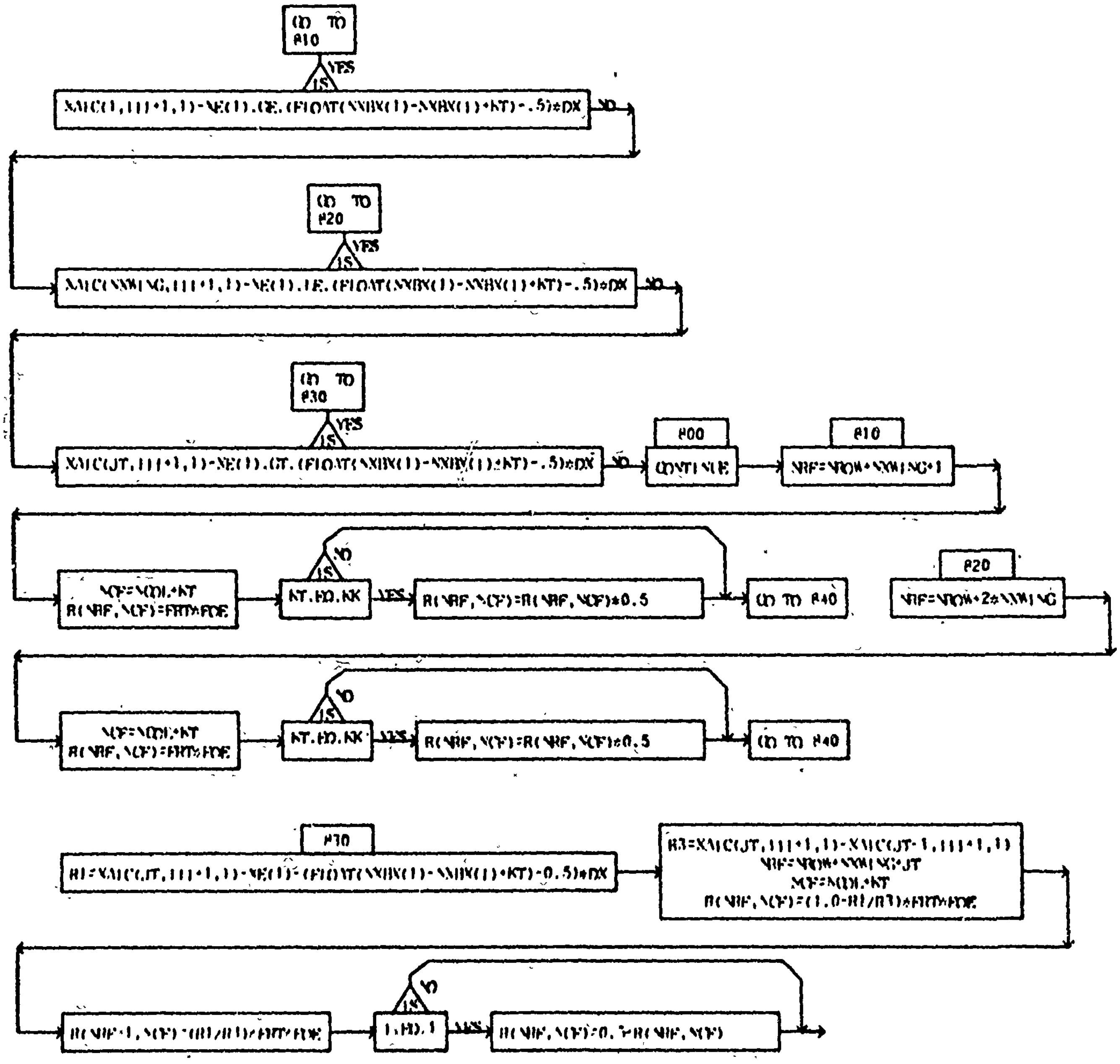
DIMENSIONED VARIABLES

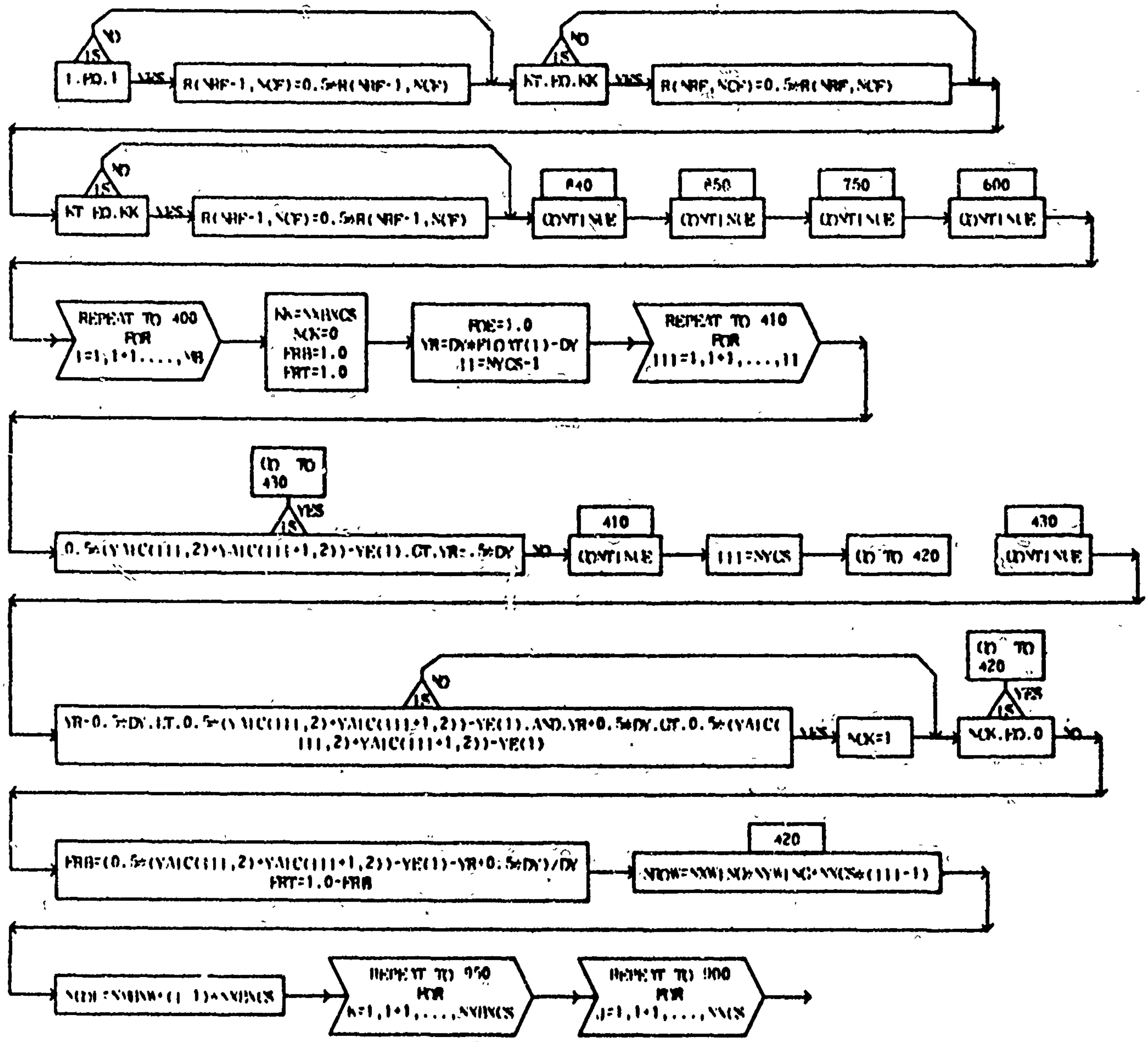
SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
R	45,45								

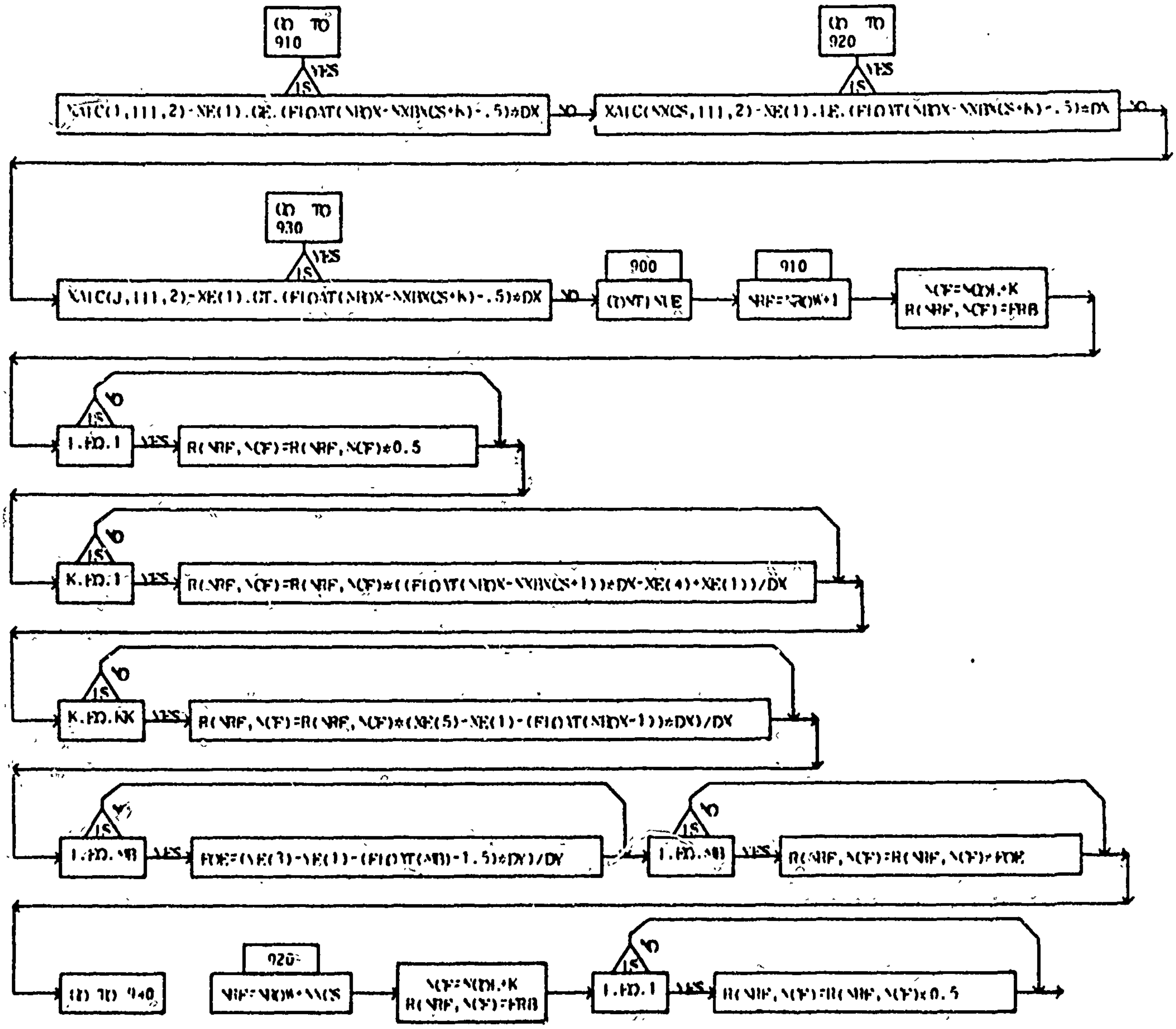

START
REPEAT TO 50
FOR
50
KCOL=0
REPEAT TO 100
FOR
100
REPEAT TO 150
FOR
REPEAT TO 150
FOR
150
REPEAT TO 600
FOR
FRB=1.0
FRT=1.0
REPEAT TO 610
FOR
GO TO
630
YES
IS
NO
610
CONTINUE
GO TO 620
630
CONTINUE
NO
IS
YES
GO TO
620
YES
IS
NO
620
650
REPEAT TO 750
FOR

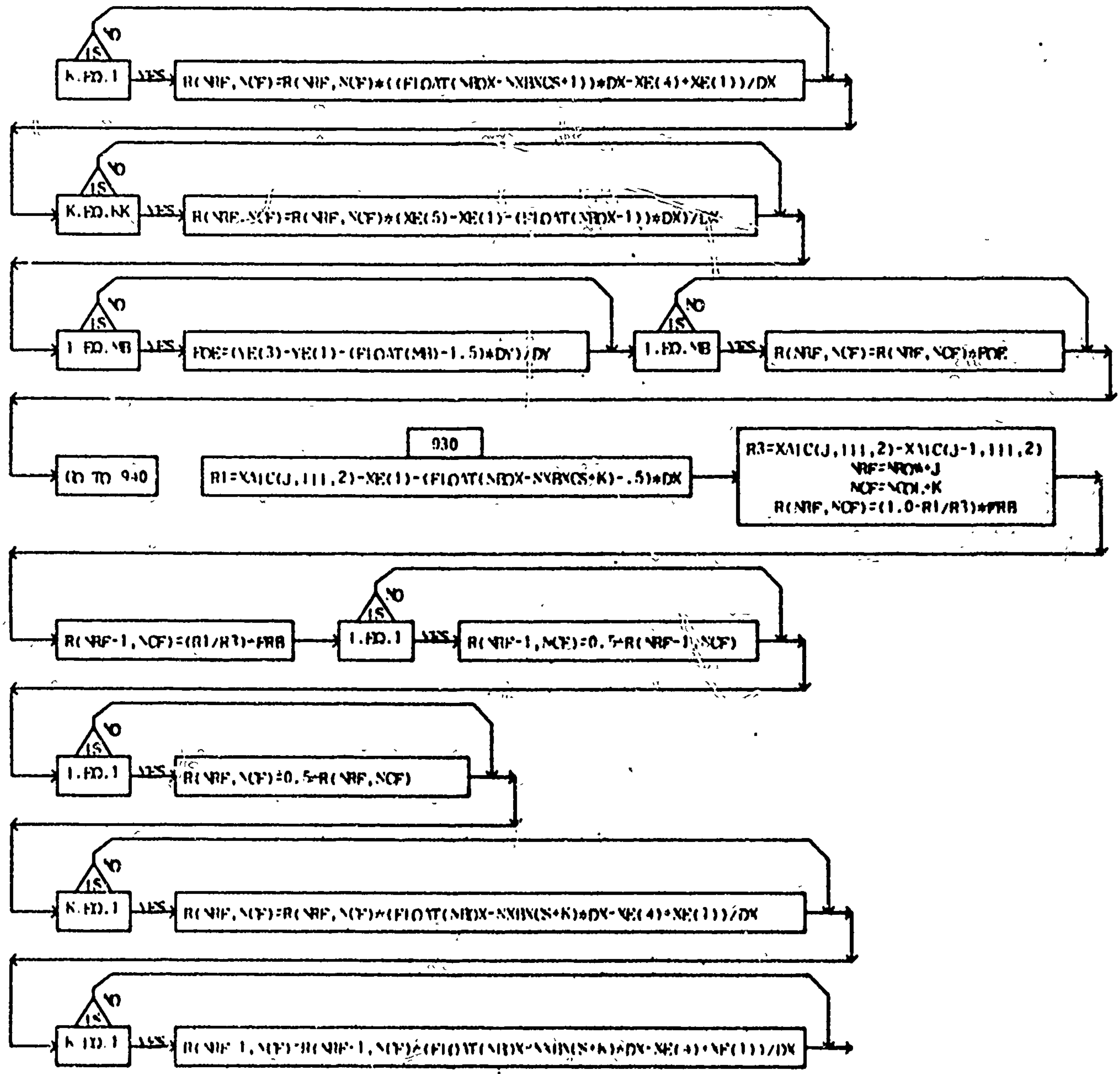

GO TO 710
YES
IS
REPEAT TO 700 FOR J=I,I+1,...,NNWING
XMC(I,III,1)-XE(1).GE.(FLOAT(NNBX(1)-NXBX(1)+K)-.5)*DX
NO
GO TO 720
YES
IS
XMC(NNWING,III,1)-XE(1).LE.(FLOAT(NXBX(1)-NXBX(1)+K)-.5)*DX
NO
GO TO 730
YES
IS
XMC(J,III,1)-XE(1).GT.(FLOAT(NNBX(1)-NXBX(1)+K)-.5)*DX
NO
700
CONTINUE
710
NRF=NROW+1
NCF=NCOL+K
R(NRF,NCF)=FRB
NO
IS
I.EQ.1
YES
R(NRF,NCF)=R(NRF,NCF)*0.5
NO
IS
K.EQ.NX
YES
R(NRF,NCF)=R(NRF,NCF)*0.5
NO
IS
I.EQ.NB
YES
FDE=(YE(3)-YE(1)-(FLOAT(NB)-1.5)*DY)/DY
NO
IS
I.EQ.NB
YES
R(NRF,NCF)=R(NRF,NCF)*FDE
GO TO 710
720
NRF=NROW+NNWING
NCF=NCOL+K
R(NRF,NCF)=FRB
NO
IS
I.EQ.1
YES
R(NRF,NCF)=R(NRF,NCF)*0.5
NO
IS
K.EQ.NX
YES
R(NRF,NCF)=R(NRF,NCF)*0.5
NO
IS
I.EQ.NB
YES
FDE=(YE(3)-YE(1)-(FLOAT(NB)-1.5)*DY)/DY

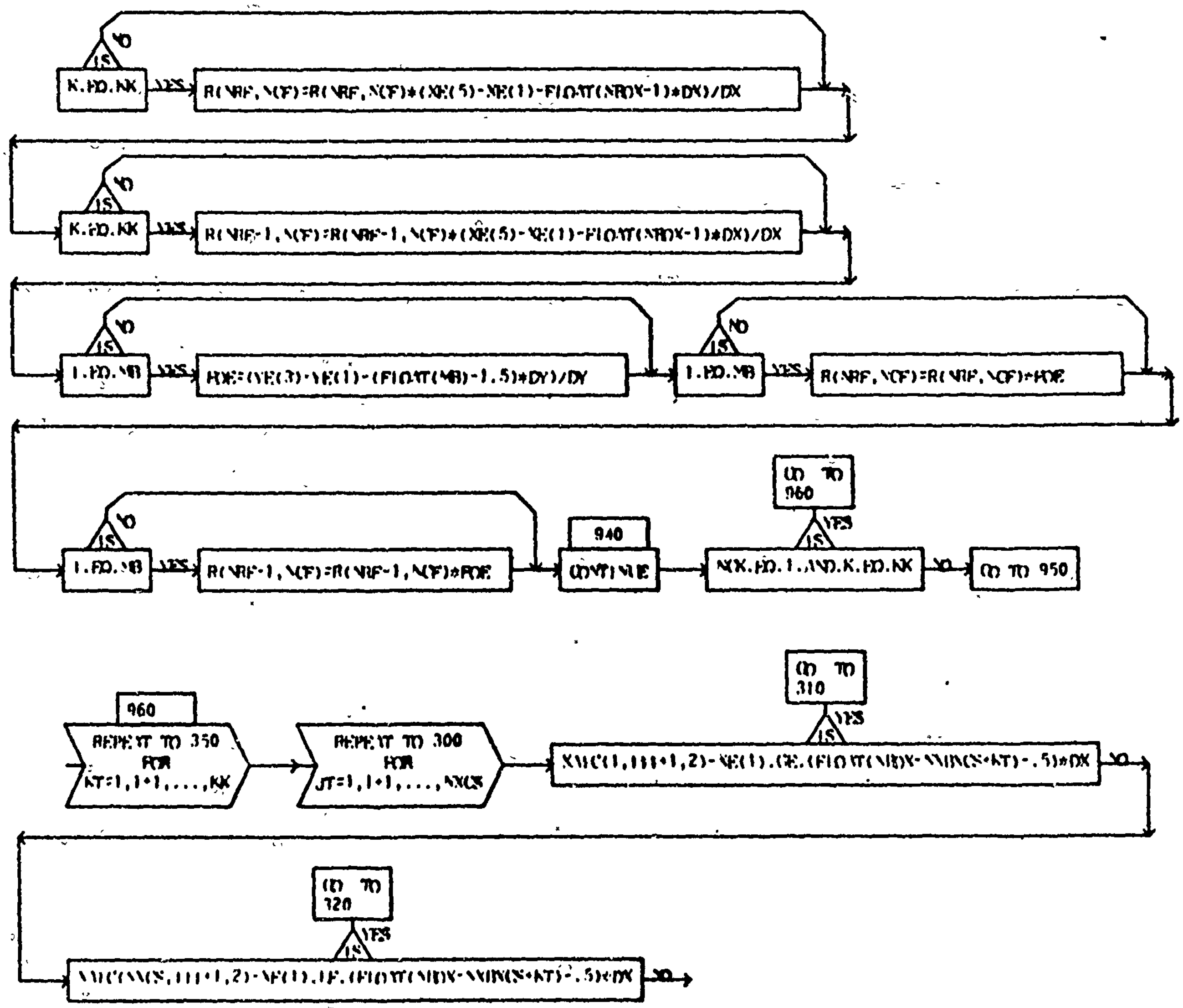

IS
NO
YES
GO TO 740
730
R3=XAIC(J,111,1)-XAIC(J-1,111,1)
R(NRF,NCF)=(1.0-R1/R3)*FRB
R(NRF-1,NCF)=(R1/R3)*FRB
I.EQ.1
R(NRF,NCF)=0.5*R(NRF,NCF)
R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
K.EQ.KK
R(NRF,NCF)=R(NRF,NCF)*0.5
R(NRF-1,NCF)=R(NRF-1,NCF)*0.5
740
CONTINUE
GO TO 760
GO TO 750
760

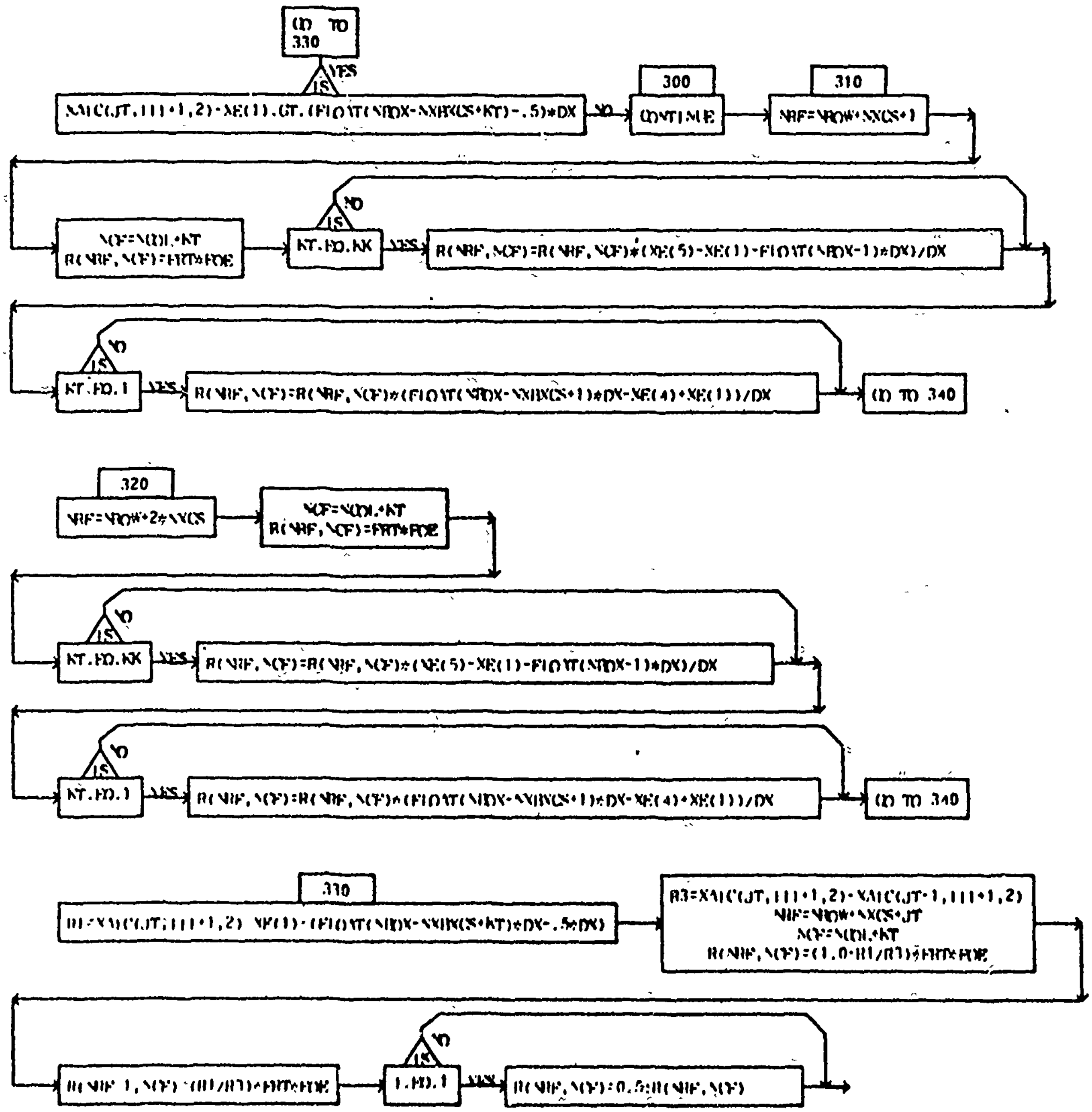

GO TO 810
IS
YES
XMC(I,III+1,1)-XE(I).GE.(FLOAT(NNBX(I)-NNBX(I)+KT)-.5)*DX
NO
GO TO 820
IS
YES
XMC(NNWING,III+1,1)-XE(I).LE.(FLOAT(NNBX(I)-NNBX(I)+KT)-.5)*DX
NO
GO TO 830
IS
YES
XMC(JT,III+1,1)-XE(I).GT.(FLOAT(NNBX(I)-NNBX(I)+KT)-.5)*DX
NO
800
CONTINUE
810
NRF=NROW+NNWING+1
NCF=NCOL+KT
R(NRF,NCF)=FRT*FDE
IS
NO
KT.EQ.KK
YES
R(NRF,NCF)=R(NRF,NCF)*0.5
GO TO 840
820
NRF=NROW+2*NNWING
NCF=NCOL+KT
R(NRF,NCF)=FRT*FDE
IS
NO
KT.EQ.KK
YES
R(NRF,NCF)=R(NRF,NCF)*0.5
GO TO 840
830
R1=XMC(JT,III+1,1)-XE(I)-(FLOAT(NNBX(I)-NNBX(I)+KT)-0.5)*DX
R3=XMC(JT,III+1,1)-XMC(JT-1,III+1,1)
NRF=NROW+NNWING+JT
NCF=NCOL+KT
R(NRF,NCF)=(1.0-R1/R3)*FRT*FDE
R(NRF+1,NCF)=(R1/R3)*FRT*FDE
IS
NO
I.EQ.1
YES
R(NRF,NCF)=0.5*R(NRF,NCF)

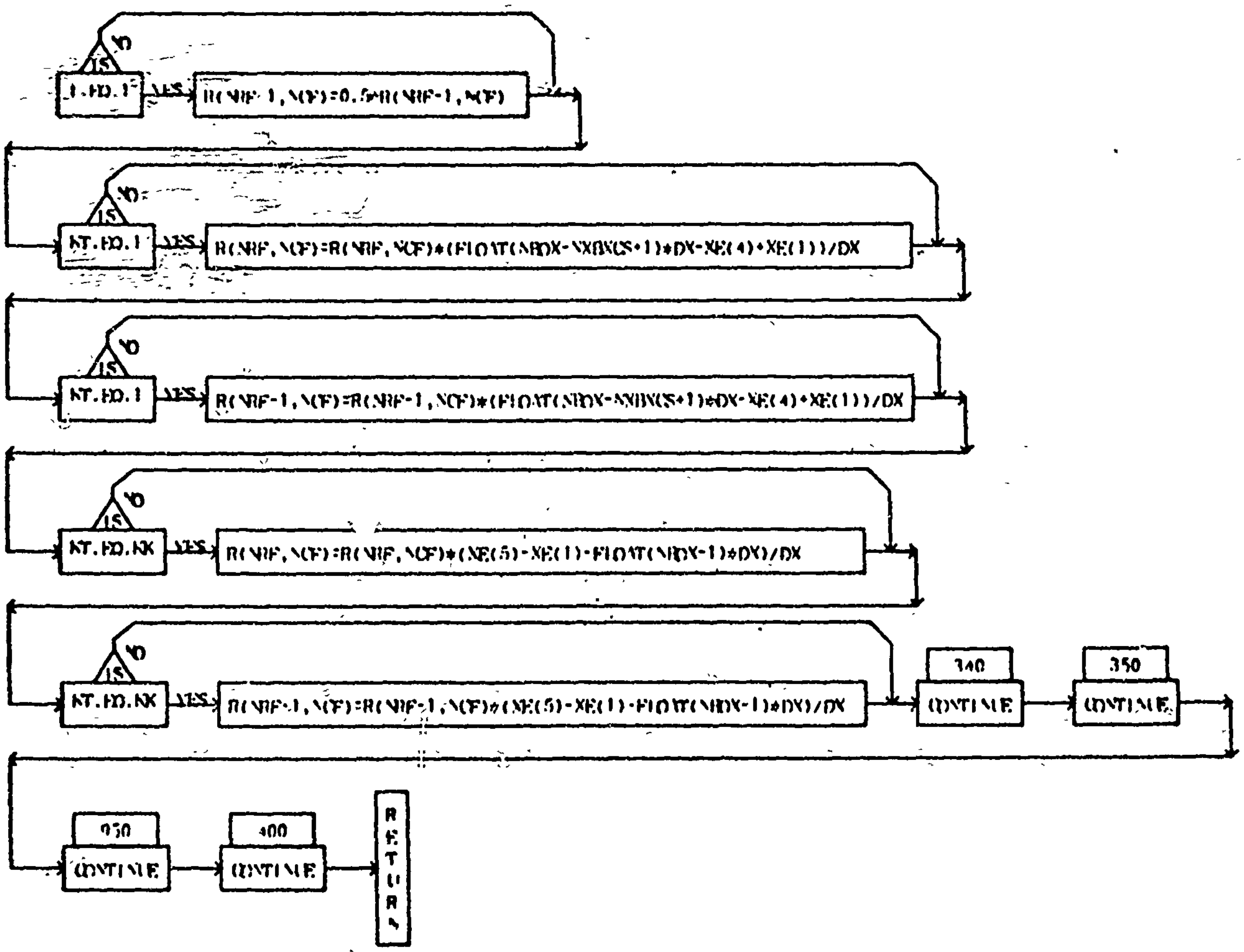


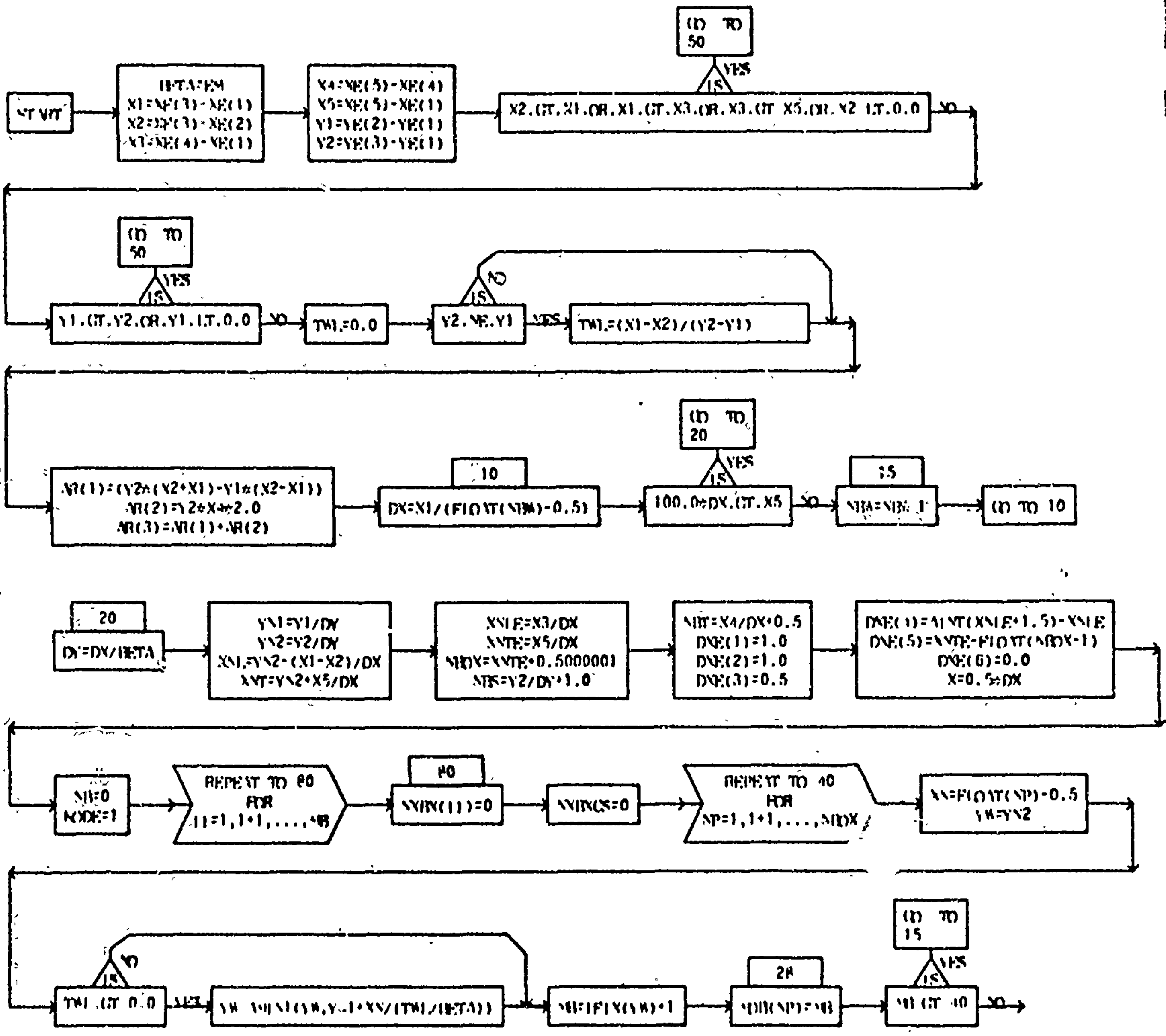

GO TO 910
YES
IS
XALC(1,111,2)-XE(1).GE.(FLOAT(NDX-NXBCS+K)-.5)*DX
NO
GO TO 920
XALC(NXCS,111,2)-XE(1).LE.(FLOAT(NDX-NXBCS+K)-.5)*DX
GO TO 930
XALC(J,111,2)-XE(1).GT.(FLOAT(NDX-NXBCS+K)-.5)*DX
900
CONTINUE
910
NRF=NROW+1
NCF=NCOL+K
R(NRF,NCF)=FRB
I.EQ.1
R(NRF,NCF)=R(NRF,NCF)*0.5
K.EQ.1
R(NRF,NCF)=R(NRF,NCF)*((FLOAT(NDX-NXBCS+1))*DX-XE(4)+XE(1))/DX
K.EQ.NX
R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)-(FLOAT(NDX-1))*DX)/DX
I.EQ.NB
FOR=(YE(3)-YE(1)-(FLOAT(NB)-1.5)*DY)/DY
R(NRF,NCF)=R(NRF,NCF)*FOR
GO TO 940
920
NRF=NROW+NXCS
I.EQ.1
R(NRF,NCF)=R(NRF,NCF)*0.5

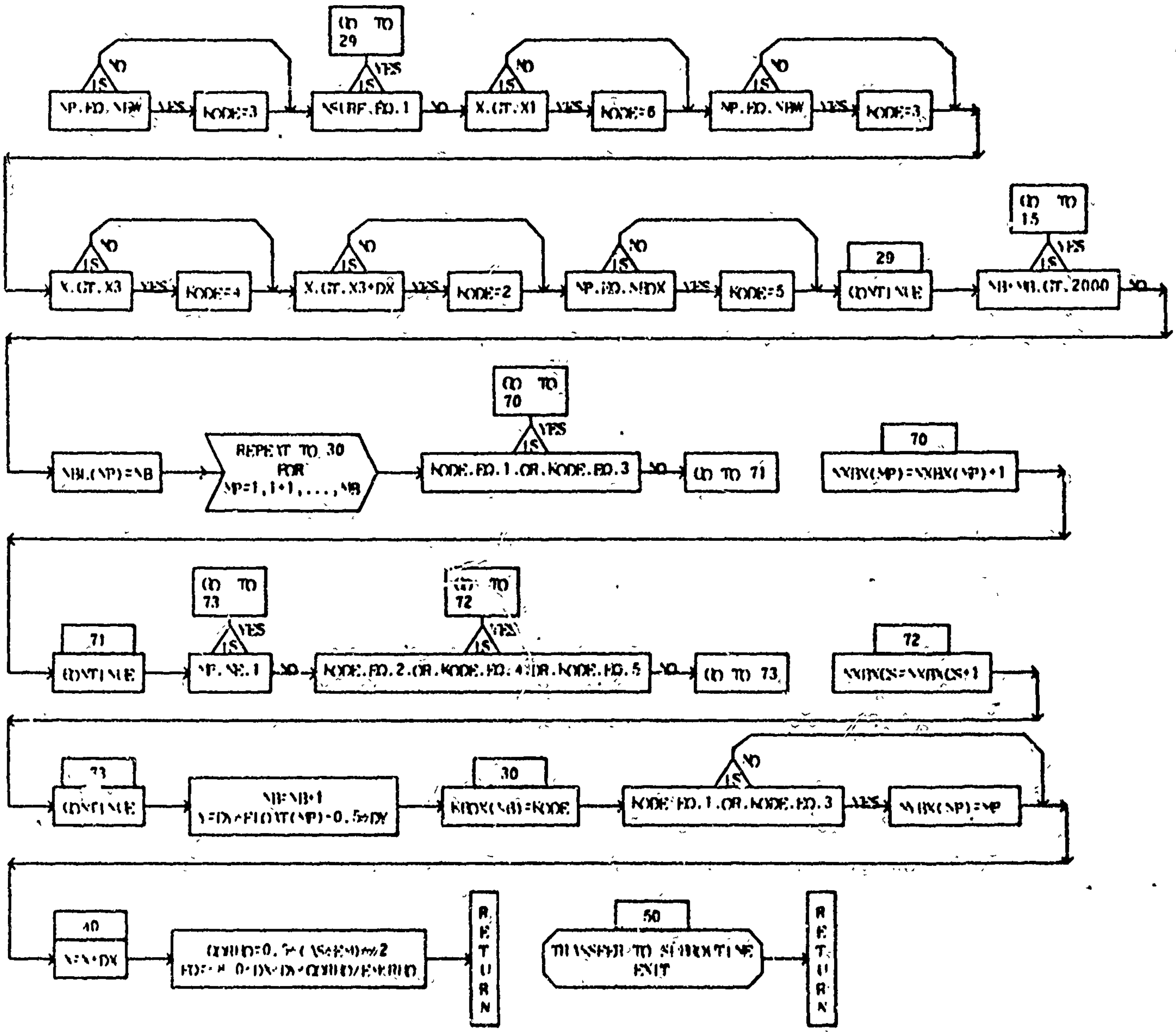

IS K.EQ.1
NO
YES
R(NRF,NCF)=R(NRF,NCF)*((FLOAT(NBDX-NXBNCS+1))*DX-XE(4)+XE(1))/DX
IS K.EQ.NK
NO
YES
R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)-(FLOAT(NBDX-1))*DX)/DX
IS I.EQ.NB
NO
YES
FOE=(YE(3)-YE(1)-(FLOAT(MB)-1.5)*DY)/DY
IS I.EQ.NB
NO
YES
R(NRF,NCF)=R(NRF,NCF)*FOE
GO TO 940
930
R1=XAIC(J,111,2)-XE(1)-(FLOAT(NBDX-NXBNCS+K)-.5)*DX
R3=XAIC(J,111,2)-XAIC(J-1,111,2)
NRF=NROW+J
NCF=NCOL+K
R(NRF,NCF)=(1.0-R1/R3)*FRB
R(NRF-1,NCF)=(R1/R3)*FRB
IS I.EQ.1
NO
YES
R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
IS I.EQ.1
NO
YES
R(NRF,NCF)=0.5*R(NRF,NCF)
IS K.EQ.1
NO
YES
R(NRF,NCF)=R(NRF,NCF)*(FLOAT(NBDX-NXBN(S+K)*DX-XE(4)+XE(1))/DX
IS K.EQ.1
NO
YES
R(NRF-1,NCF)=R(NRF-1,NCF)*(FLOAT(NBDX-NXBN(S+K)*DX-XE(4)+XE(1))/DX


IS
NO
YES
K.EQ.NK
K.EQ.KK
I.EQ.MB
CONTINUE
940
960
GO TO 960
GO TO 950
GO TO 310
GO TO 320
REPEAT TO 350 FOR
REPEAT TO 300 FOR

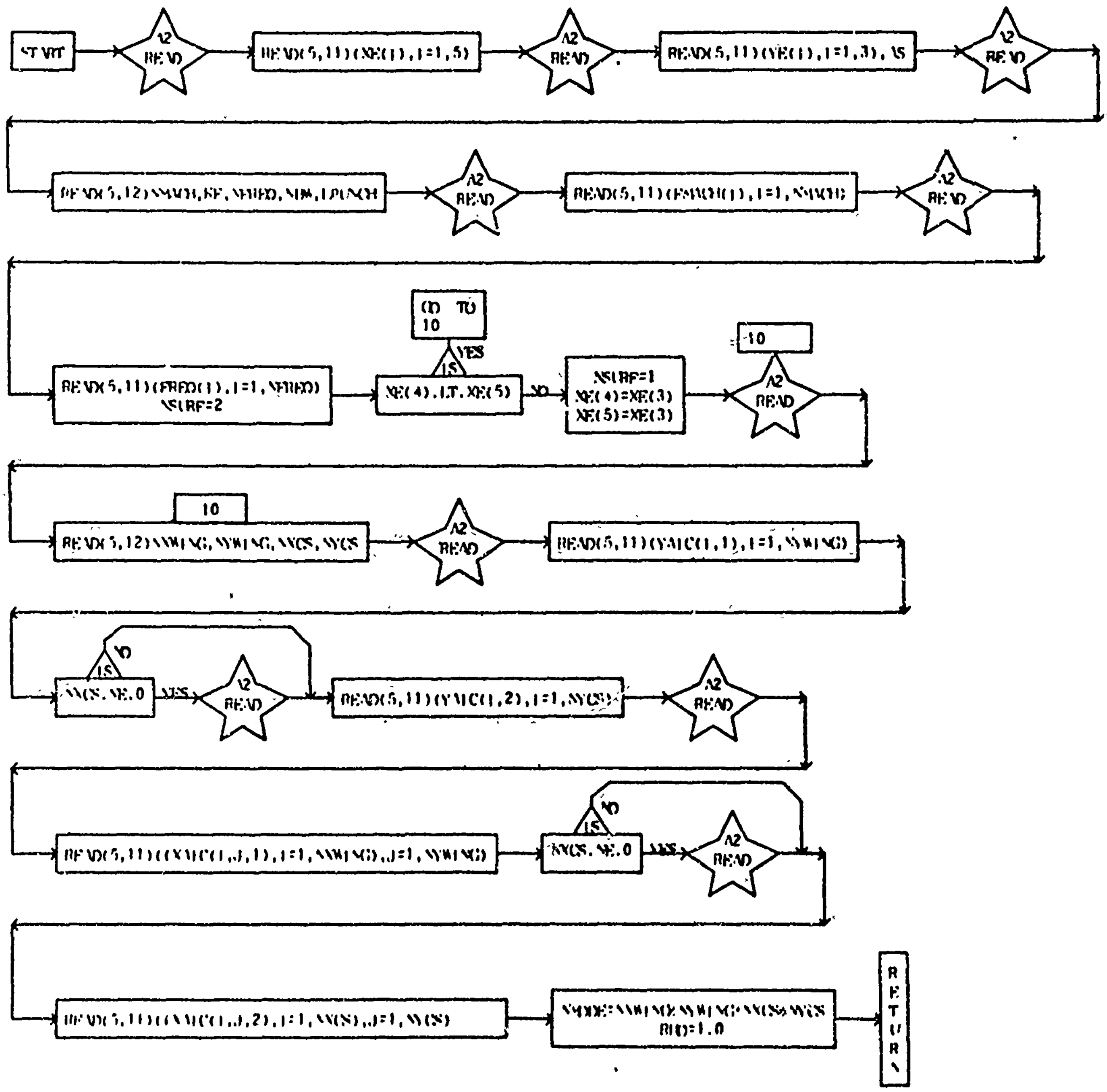

GO TO 330
YES
IS
.GT.
NO
300
CONTINUE
310
NO
IS
KT.EQ.KK
YES
NO
IS
KT.EQ.1
YES
GO TO 340
320
NO
IS
KT.EQ.KK
YES
NO
IS
KT.EQ.1
YES
GO TO 340
330
NO
IS
I.EQ.1
YES

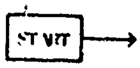

I.EQ.1
IS
NO
YES
R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
NT.EQ.1
R(NRF,NCF)=R(NRF,NCF)*(FLOAT(NBDX-NXBXCS+1)*DX-XE(4)+XE(1))/DX
NT.EQ.1
R(NRF-1,NCF)=R(NRF-1,NCF)*(FLOAT(NBDX-NXBXCS+1)*DX-XE(4)+XE(1))/DX
NT.EQ.NX
R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)-FLOAT(NBDX-1)*DX)/DX
NT.EQ.NX
R(NRF-1,NCF)=R(NRF-1,NCF)*(XE(5)-XE(1)-FLOAT(NBDX-1)*DX)/DX
340
CONTINUE
350
CONTINUE
930
CONTINUE
400
CONTINUE
RETURN

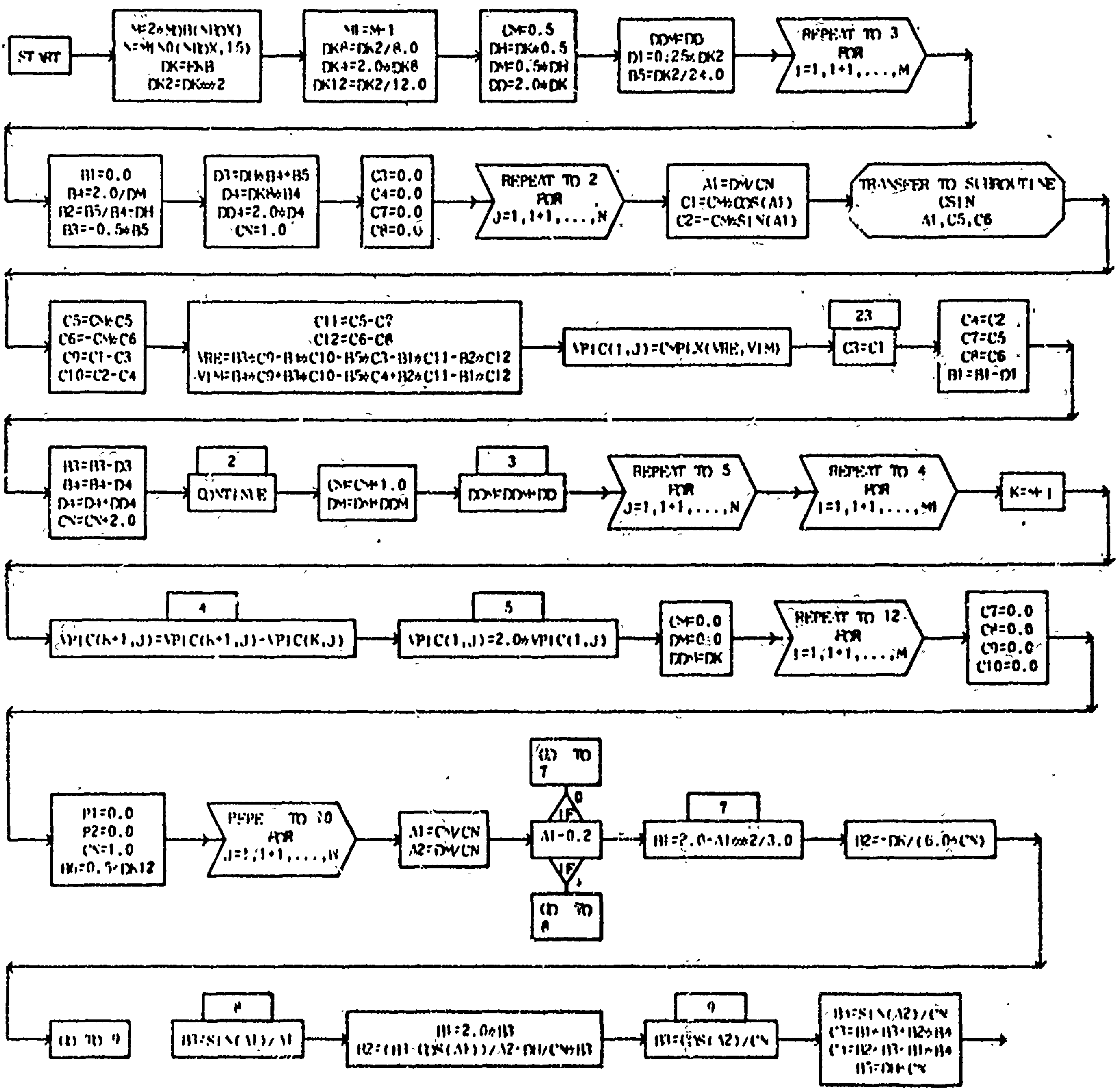

START
GO TO 50
YES
IS
NO
TWL=0.0
Y2.NE.Y1
TWL=(X1-X2)/(Y2-Y1)
AR(2)=Y2*X*2.0
AR(3)=AR(1)+AR(2)
10
DX=X1/(FLOAT(NBM)-0.5)
GO TO 20
15
GO TO 10
20
DY=DX/BETA
YN1=Y1/DY
YN2=Y2/DY
XNT=YN2+X5/DX
XNLE=X3/DX
XNTE=X5/DX
NBS=Y2/DY+1.0
DNE(1)=1.0
DNE(2)=1.0
DNE(3)=0.5
DNE(6)=0.0
X=0.5*DX
NB=0
NODE=1
REPEAT TO 80
FOR
80
REPEAT TO 40
FOR
GO TO 15
28

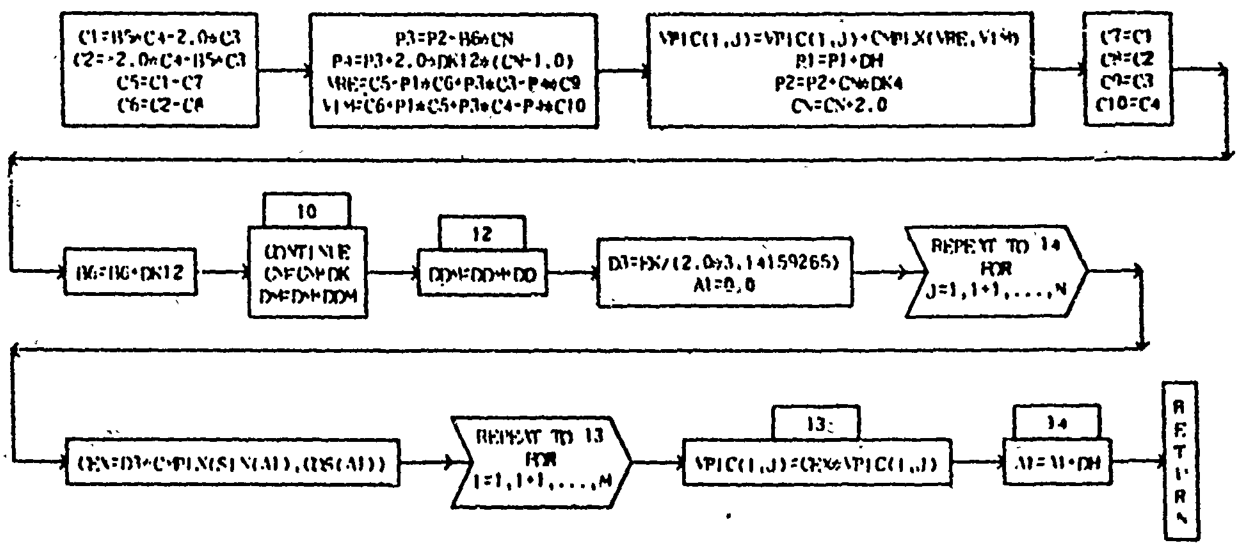

GO TO 29
NP.EQ.NBW
KODE=3
X.GT.X1
KODE=6
KODE=3
GO TO 15
X.GT.X3
KODE=4
X.GT.X3+DX
KODE=2
NP.EQ.NDX
KODE=5
29
CONTINUE
GO TO 70
REPEAT TO 30
FOR
KODE.EQ.1.OR.KODE.EQ.3
GO TO 71
70
GO TO 73
GO TO 72
71
CONTINUE
KODE.EQ.2.OR.KODE.EQ.4.OR.KODE.EQ.5
GO TO 73
72
CONTINUE
30
KODE.EQ.1.OR.KODE.EQ.3
40
50
TRANSFER TO SUBROUTINE EXIT
RETURN
RETURN

אותם אותם

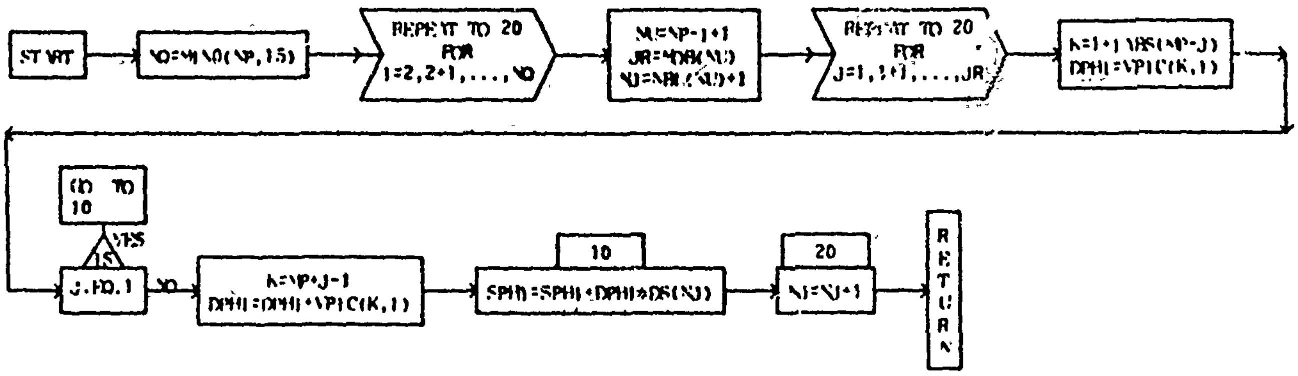

START
A2 READ
READ(5,11)(XE(I),I=1,5)
READ(5,11)(YE(I),I=1,3),XS
READ(5,12)NMACH,KF,NFREQ,NDW,LPUNCH
READ(5,11)(FMACH(I),I=1,NMACH)
READ(5,11)(FREQ(I),I=1,NFREQ)
NSURF=2
IS
XE(4).LT.XE(5)
YES
NO
GO TO 10
NSURF=1
XE(4)=XE(3)
XE(5)=XE(3)
10
READ(5,12)NXWING,NYWING,NXCS,NYCS
READ(5,11)(YAIC(I,1),I=1,NYWING)
NXCS.NE.0
READ(5,11)(YAIC(I,2),I=1,NYCS)
NYCS.NE.0
R
E
T
U
R
N


START


START
M=2*MOD(NIDX)
N=MINO(NIDX,15)
DK=FNB
DK2=DK**2
MI=M+1
DK8=DK2/8.0
DK4=2.0*DK8
DK12=DK2/12.0
CM=0.5
DH=DK*0.5
DM=0.5*DH
DD=2.0*DK
DDM=DD
D1=0.25*DK2
B5=DK2/24.0
REPEAT TO 3 FOR I=1,1+1,....,M
B1=0.0
B4=2.0/DM
B2=B5/B4-DH
B3=-0.5*B5
D3=DH*B4+B5
D4=DK8*B4
DD4=2.0*D4
CN=1.0
C3=0.0
C4=0.0
C7=0.0
C8=0.0
REPEAT TO 2 FOR J=1,1+1,....,N
A1=DM/CN
C1=CM*COS(A1)
C2=-CM*SIN(A1)
TRANSFER TO SUBROUTINE CSIN A1,C5,C6
C5=CN*C5
C6=-CN*C6
C9=C1-C3
C10=C2-C4
C11=C5-C7
C12=C6-C8
VRE=B3*C9-B4*C10-B5*C3-B1*C11-B2*C12
VIM=B4*C9+B3*C10-B5*C4+B2*C11-B1*C12
VPIC(I,J)=CMPLX(VRE,VIM)
23
C3=C1
C4=C2
C7=C5
C8=C6
B1=B1-D1
B3=B3-D3
B4=B4-D4
D4=D4+DD4
CN=CN+2.0
2
CONTINUE
CM=CM+1.0
DM=DM+DDM
3
DDM=DDM+DD
REPEAT TO 5 FOR J=1,1+1,....,N
REPEAT TO 4 FOR I=1,1+1,....,MI
K=M+1
4
VPIC(K+1,J)=VPIC(K+1,J)-VPIC(K,J)
5
VPIC(1,J)=2.0*VPIC(1,J)
CM=0.0
DM=0.0
DDM=DK
REPEAT TO 12 FOR I=1,1+1,....,M
C7=0.0
C8=0.0
C9=0.0
C10=0.0
P1=0.0
P2=0.0
CN=1.0
B6=0.5*DK12
REPE TO 10 FOR J=1,1+1,....,N
A1=CM/CN
A2=DM/CN
GO TO 7
A1-0.2
IF
GO TO 8
7
B1=2.0-A1**2/3.0
B2=-DK/(6.0*CN)
GO TO 9
8
B3=SIN(A1)/A1
B1=2.0*B3
B2=(B3-COS(A1))/A2-DH/CN*B3
9
B3=COS(A2)/CN
B4=SIN(A2)/CN
C9=B1+B3+B2*B4
C10=B2*B3-B1*B4
B5=DK*CN


C1=B5*C4-2.0*C3
C5=C1-C7
C6=C2-C8
P3=P2-B6*CN
P4=P3+2.0*DK12*(CN-1.0)
VIM=C6*P1+C5*P3+C4-P4*C10
VPIC(I,J)=VPIC(I,J)+CMPLX(VRE,VIM)
P1=P1+DH
P2=P2+CN*DK4
CN=CN+2.0
C7=C1
C8=C2
C9=C3
C10=C4
B6=B6+DK12
10
CONTINUE
12
DD=DD+DD
D3=EX/(2.0*3.14159265)
AI=0.0
REPEAT TO 14
FOR
J=1,1+1,...,N
CEX=D3*CMPLX(SIN(AI),COS(AI))
REPEAT TO 13
FOR
I=1,1+1,...,M
13
VPIC(I,J)=CEX*VPIC(I,J)
14
AI=AI+DH
RETURN

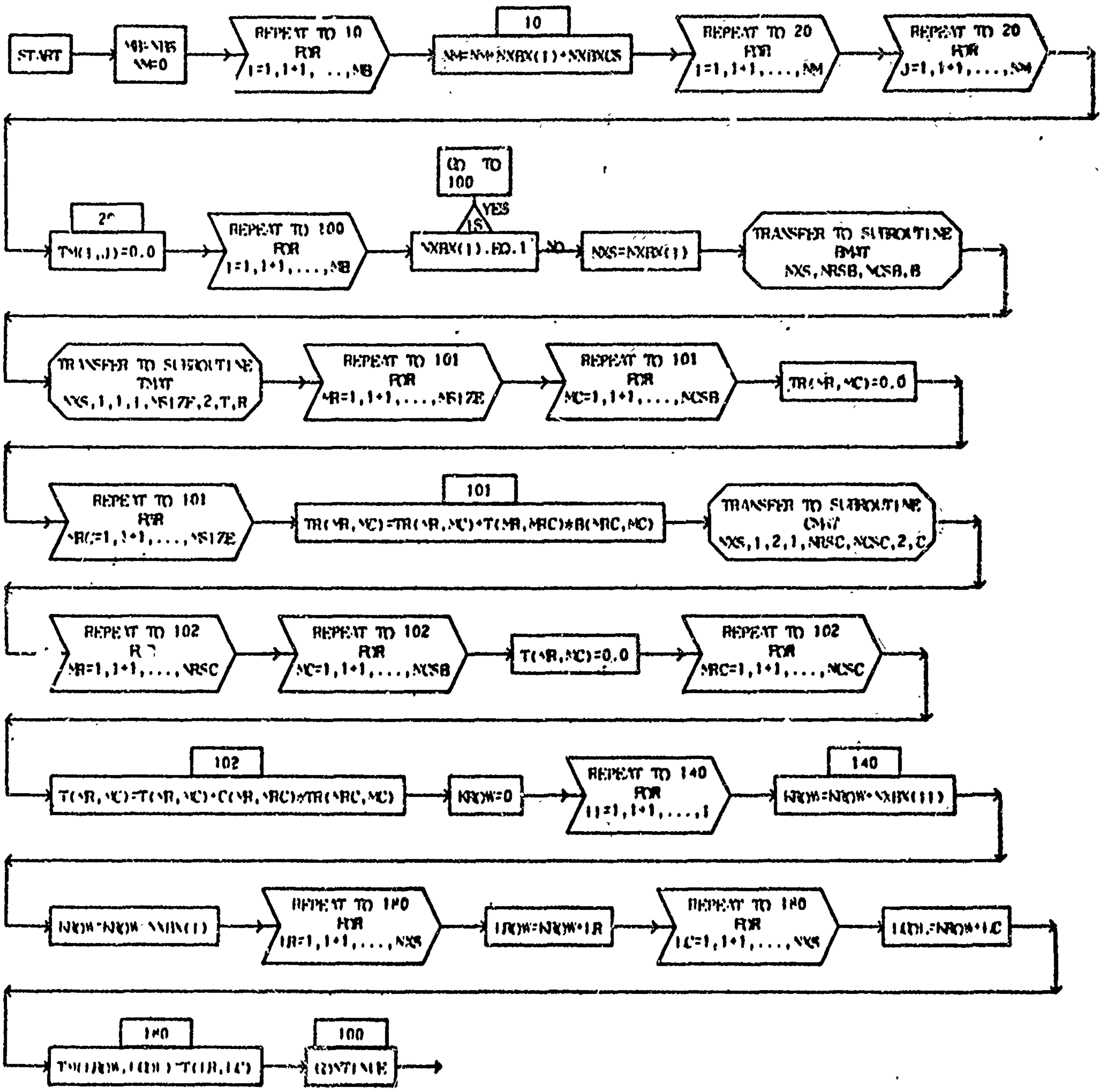
PHIB PHIB

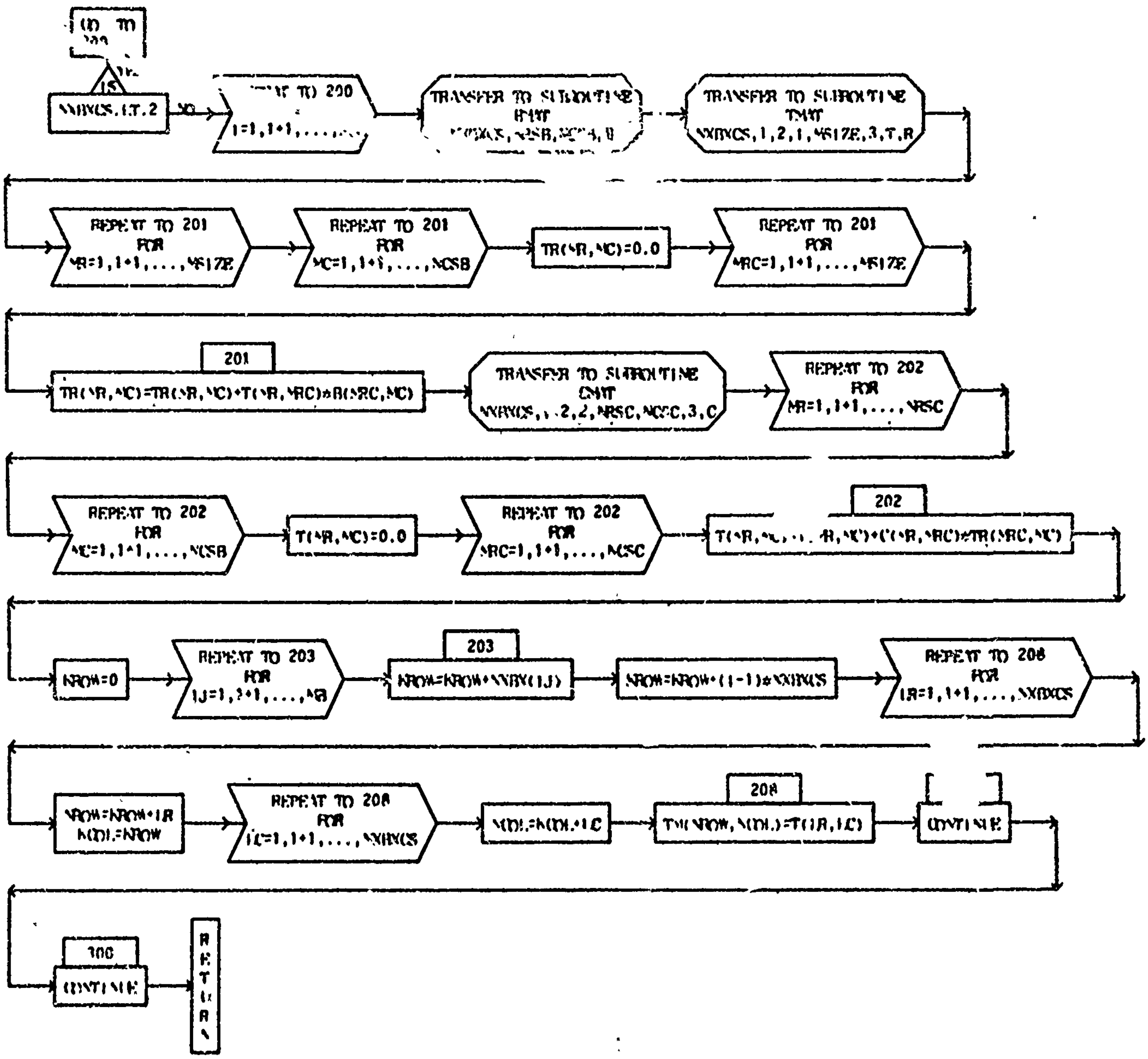

START
NO=MIN0(NP,15)
REPEAT TO 20
FOR
I=2,2+1,...,NO
RETURN
10
20

SD2 SD2

DIMENSIONED VARIABLES

SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
S	45,45	R	45,45	C	45,45	B	45,45	T	45,45
TR	45,45	TM	45,45						

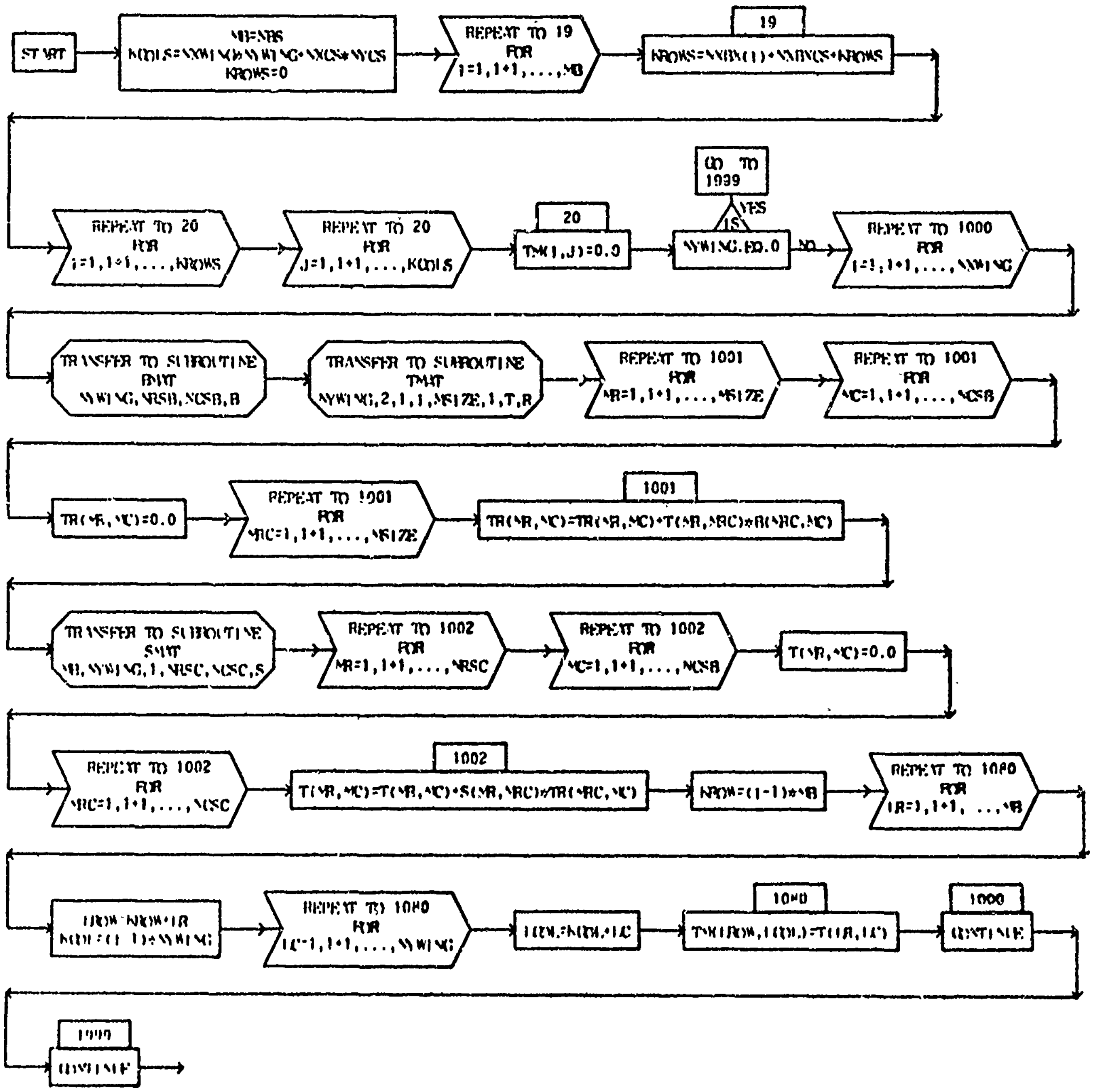

START
NB=NB
NM=0
REPEAT TO 10 FOR I=1,I+1,...,NB
10
NM=NM+NXBX(I)+NXBXCS
REPEAT TO 20 FOR I=1,I+1,...,NM
REPEAT TO 20 FOR J=1,I+1,...,NM
20
TM(I,J)=0.0
REPEAT TO 100 FOR I=1,I+1,...,NB
GO TO 100
YES
IS
NXBX(I).EQ.1
NO
NXS=NXBX(I)
TRANSFER TO SUBROUTINE BMAT NXS,NRSB,NCSB,B
TRANSFER TO SUBROUTINE TMAT NXS,1,1,1,NSIZE,2,T,R
REPEAT TO 101 FOR MR=1,I+1,...,NSIZE
REPEAT TO 101 FOR MC=1,I+1,...,NCSB
TR(MR,MC)=0.0
REPEAT TO 101 FOR MRC=1,I+1,...,NSIZE
101
TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*B(MRC,MC)
TRANSFER TO SUBROUTINE CMAT NXS,1,2,1,NRSC,NCSC,2,C
REPEAT TO 102 FOR MR=1,I+1,...,NRSC
REPEAT TO 102 FOR MC=1,I+1,...,NCSB
T(MR,MC)=0.0
REPEAT TO 102 FOR MRC=1,I+1,...,NCSC
102
T(MR,MC)=T(MR,MC)+C(MR,MRC)*TR(MRC,MC)
KROW=0
REPEAT TO 140 FOR II=1,I+1,...,I
140
KROW=KROW+NXBX(II)
KROW=KROW-NXBX(I)
REPEAT TO 180 FOR LR=1,I+1,...,NXS
LROW=KROW+LR
REPEAT TO 180 FOR LC=1,I+1,...,NXS
LCOL=KROW+LC
180
TM(LROW,LCOL)=T(LR,LC)
100
CONTINUE

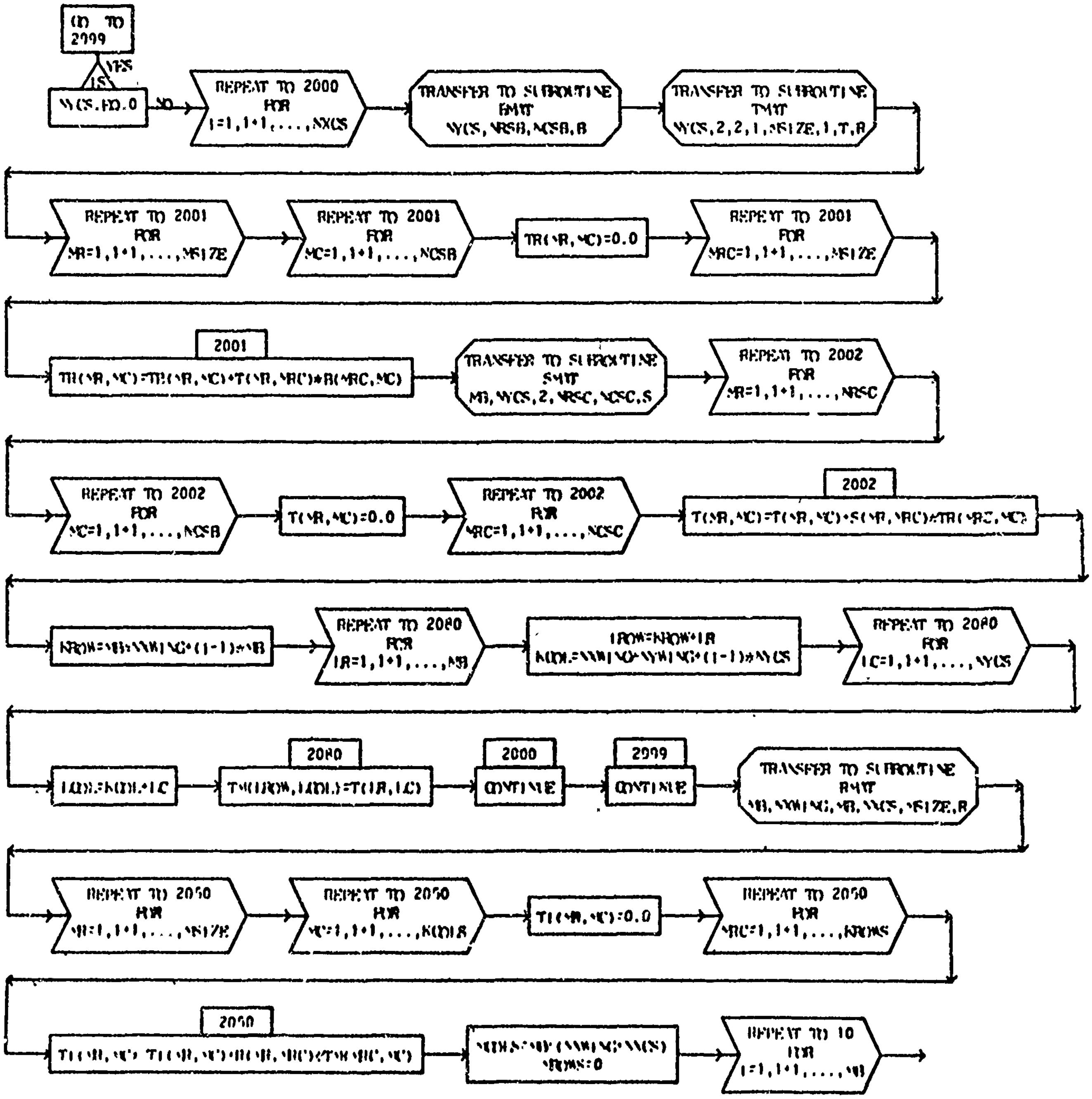

GO TO 300
IS
NNBCS.LT.2
YES
NO
REPEAT TO 200
TRANSFER TO SUBROUTINE
TRANSFER TO SUBROUTINE
REPEAT TO 201
FOR
REPEAT TO 201
FOR
TR(MR,MC)=0.0
REPEAT TO 201
FOR
201
TRANSFER TO SUBROUTINE
REPEAT TO 202
FOR
REPEAT TO 202
FOR
T(MR,MC)=0.0
REPEAT TO 202
FOR
202
NROW=0
REPEAT TO 203
FOR
203
REPEAT TO 208
FOR
REPEAT TO 208
FOR
208
CONTINUE
300
CONTINUE
RETURN

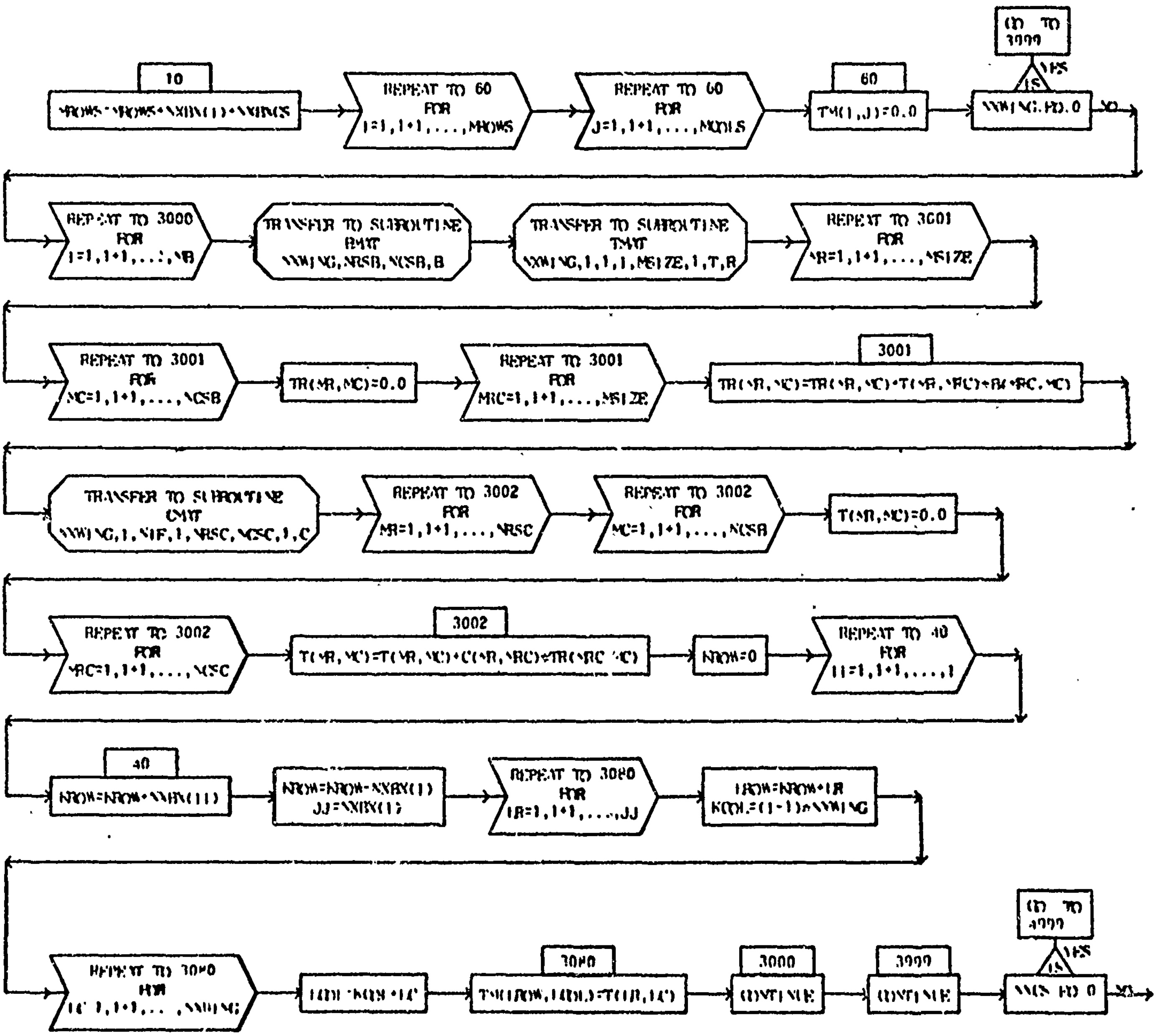
TRAMP

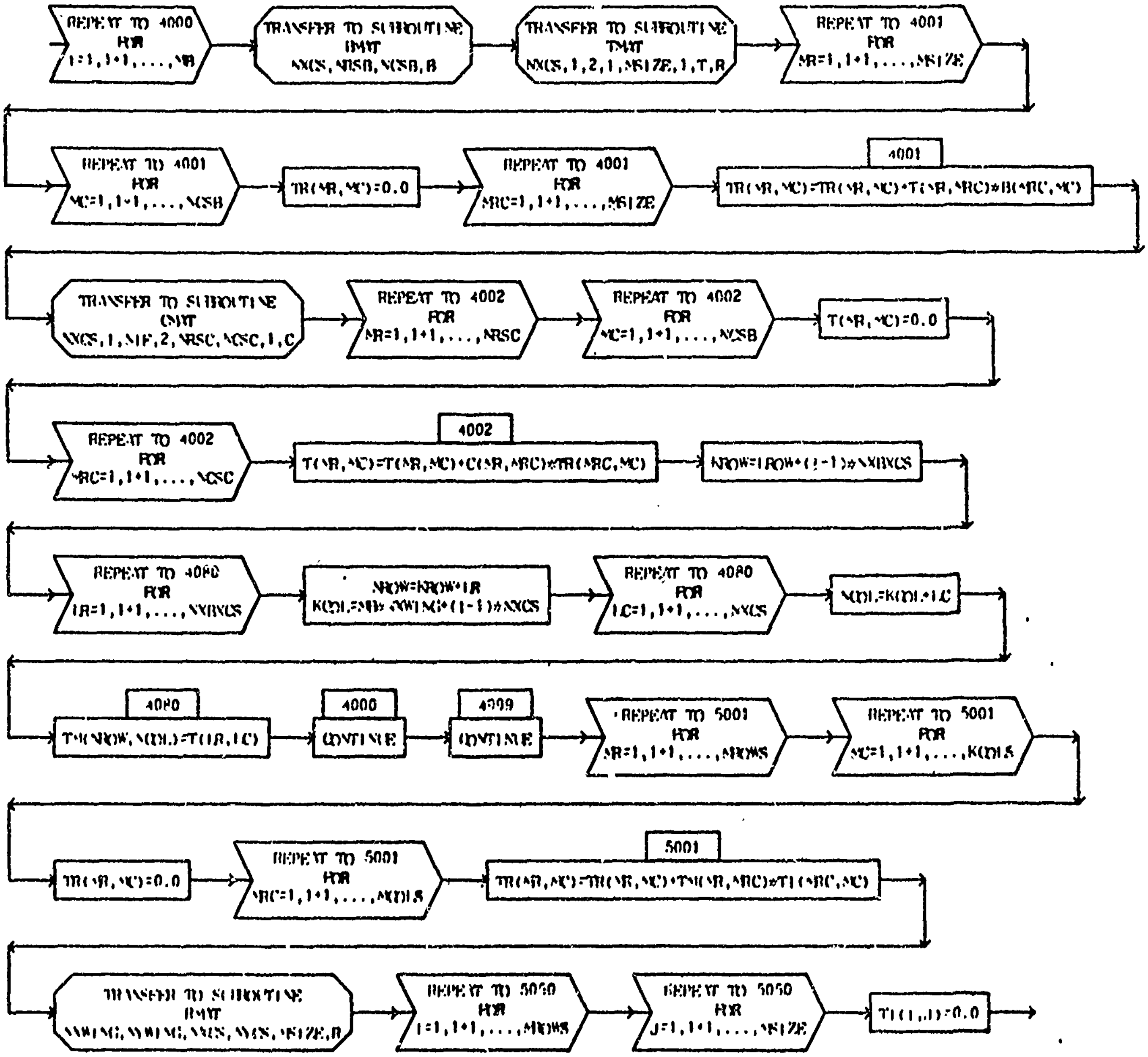
DIMENSIONED VARIABLES

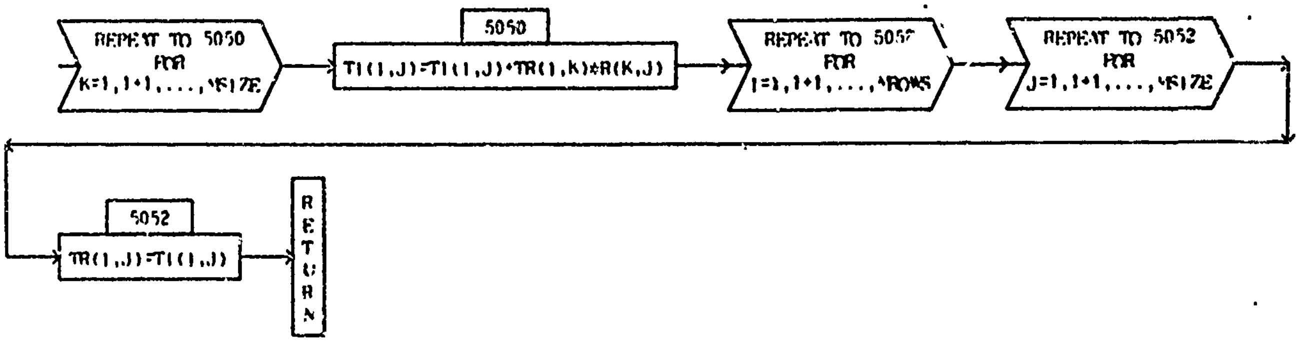
SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
S	45,45	R	45,45	C	45,45	B	45,45	T	45,45
TR	45,45	TI	45,45	TM	45,45				


START
REPEAT TO 19
FOR
19
REPEAT TO 20
FOR
REPEAT TO 20
FOR
20
GO TO
1999
YES
IS
NO
REPEAT TO 1000
FOR
TRANSFER TO SUBROUTINE
TRANSFER TO SUBROUTINE
REPEAT TO 1001
FOR
REPEAT TO 1001
FOR
REPEAT TO 1001
FOR
1001
TRANSFER TO SUBROUTINE
REPEAT TO 1002
FOR
REPEAT TO 1002
FOR
REPEAT TO 1002
FOR
1002
REPEAT TO 1080
FOR
REPEAT TO 1080
FOR
1080
1000
CONTINUE
1999
CONTINUE


GO TO 2999
YES
IS
NO
REPEAT TO 2000
FOR
TRANSFER TO SUBROUTINE
TRANSFER TO SUBROUTINE
REPEAT TO 2001
FOR
REPEAT TO 2001
FOR
TR(MR,MC)=0.0
REPEAT TO 2001
FOR
2001
TRANSFER TO SUBROUTINE
REPEAT TO 2002
FOR
REPEAT TO 2002
FOR
T(MR,MC)=0.0
REPEAT TO 2002
FOR
2002
REPEAT TO 2080
FOR
REPEAT TO 2080
FOR
2080
2000
CONTINUE
2999
CONTINUE
TRANSFER TO SUBROUTINE
REPEAT TO 2050
FOR
REPEAT TO 2050
FOR
T1(MR,MC)=0.0
REPEAT TO 2050
FOR
2050
REPEAT TO 10
FOR



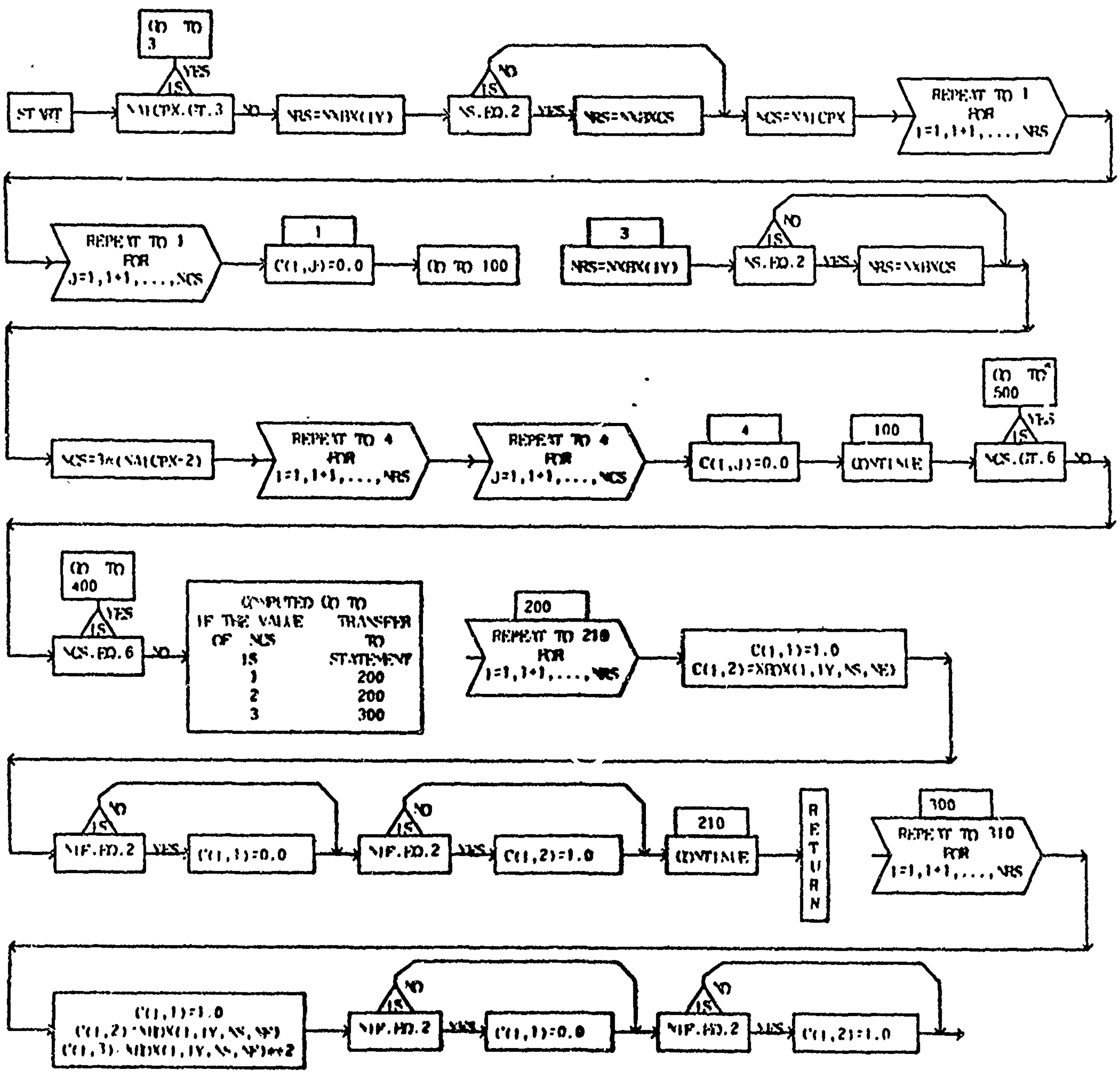

REPEAT TO 4000 FOR I=1,I+1,...,NB
TRANSFER TO SUBROUTINE
REPEAT TO 4001 FOR NR=1,1+1,...,NSIZE
REPEAT TO 4001 FOR NC=1,1+1,...,NCSB
TR(NR,NC)=0.0
REPEAT TO 4001 FOR NRC=1,1+1,...,NSIZE
4001
TR(NR,NC)=TR(NR,NC)+T(NR,NRC)*B(NRC,NC)
TRANSFER TO SUBROUTINE
REPEAT TO 4002 FOR NR=1,1+1,...,NRSC
REPEAT TO 4002 FOR NC=1,1+1,...,NCSB
T(NR,NC)=0.0
REPEAT TO 4002 FOR NRC=1,1+1,...,NCSC
4002
T(NR,NC)=T(NR,NC)+C(NR,NRC)*TR(NRC,NC)
REPEAT TO 4080 FOR IR=1,1+1,...,NXBNCS
REPEAT TO 4080 FOR LC=1,1+1,...,NNCS
NCOL=KCOL+LC
4080
4000
CONTINUE
CONTINUE
REPEAT TO 5001 FOR NR=1,1+1,...,NROWS
REPEAT TO 5001 FOR NC=1,1+1,...,KCOLS
TR(NR,NC)=0.0
REPEAT TO 5001
5001
TRANSFER TO SUBROUTINE
REPEAT TO 5050 FOR I=1,1+1,...,NROWS
REPEAT TO 5050 FOR J=1,1+1,...,NSIZE
T1(I,J)=0.0

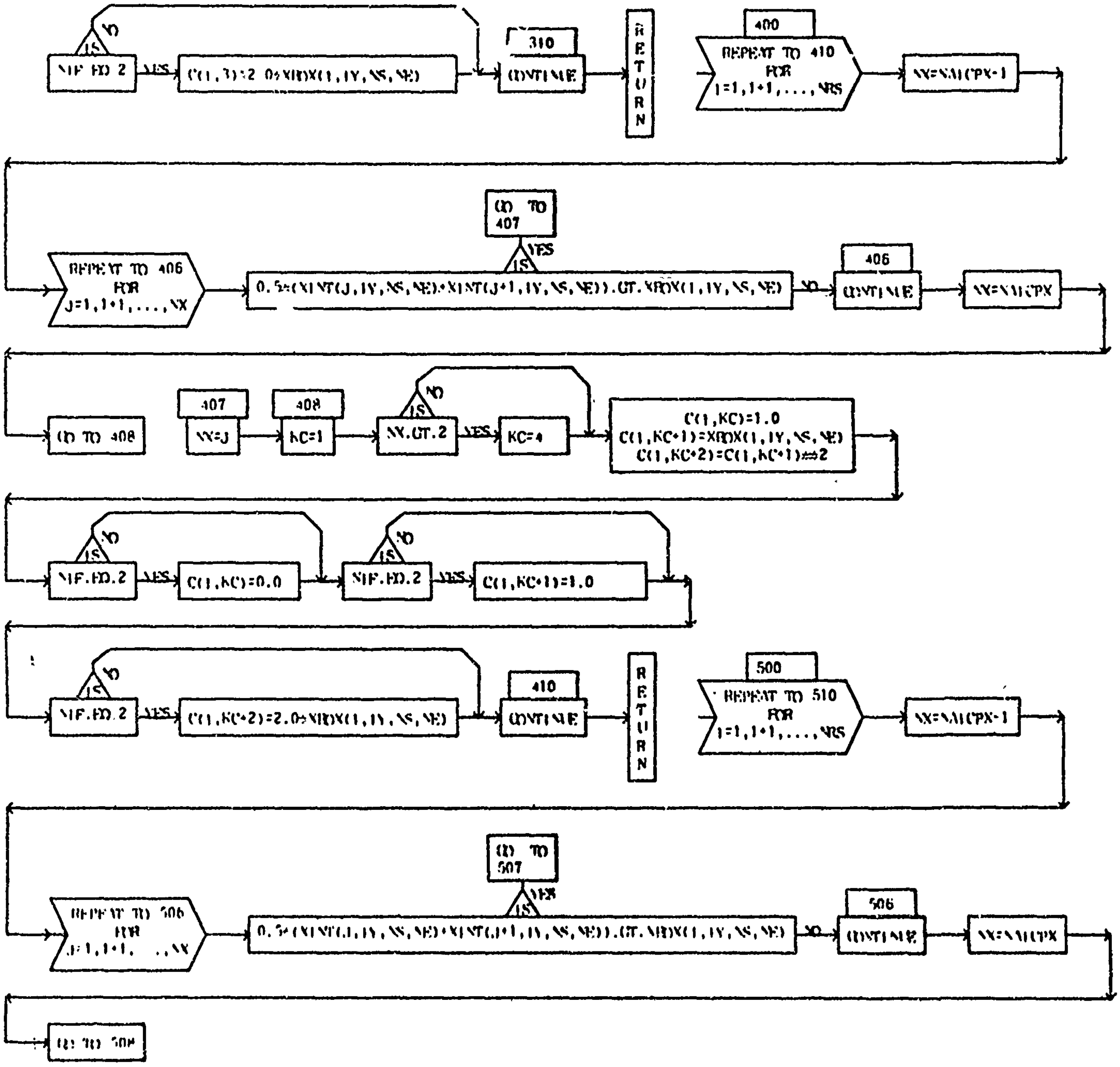

REPEAT TO 5050
FOR
K=1,1+1,...,NSIZE
5050
TI(I,J)=TI(I,J)+TR(I,K)*R(K,J)
REPEAT TO 5052
FOR
I=1,1+1,...,NROWS
REPEAT TO 5052
FOR
J=1,1+1,...,NSIZE
5052
TR(I,J)=TI(I,J)
RETURN

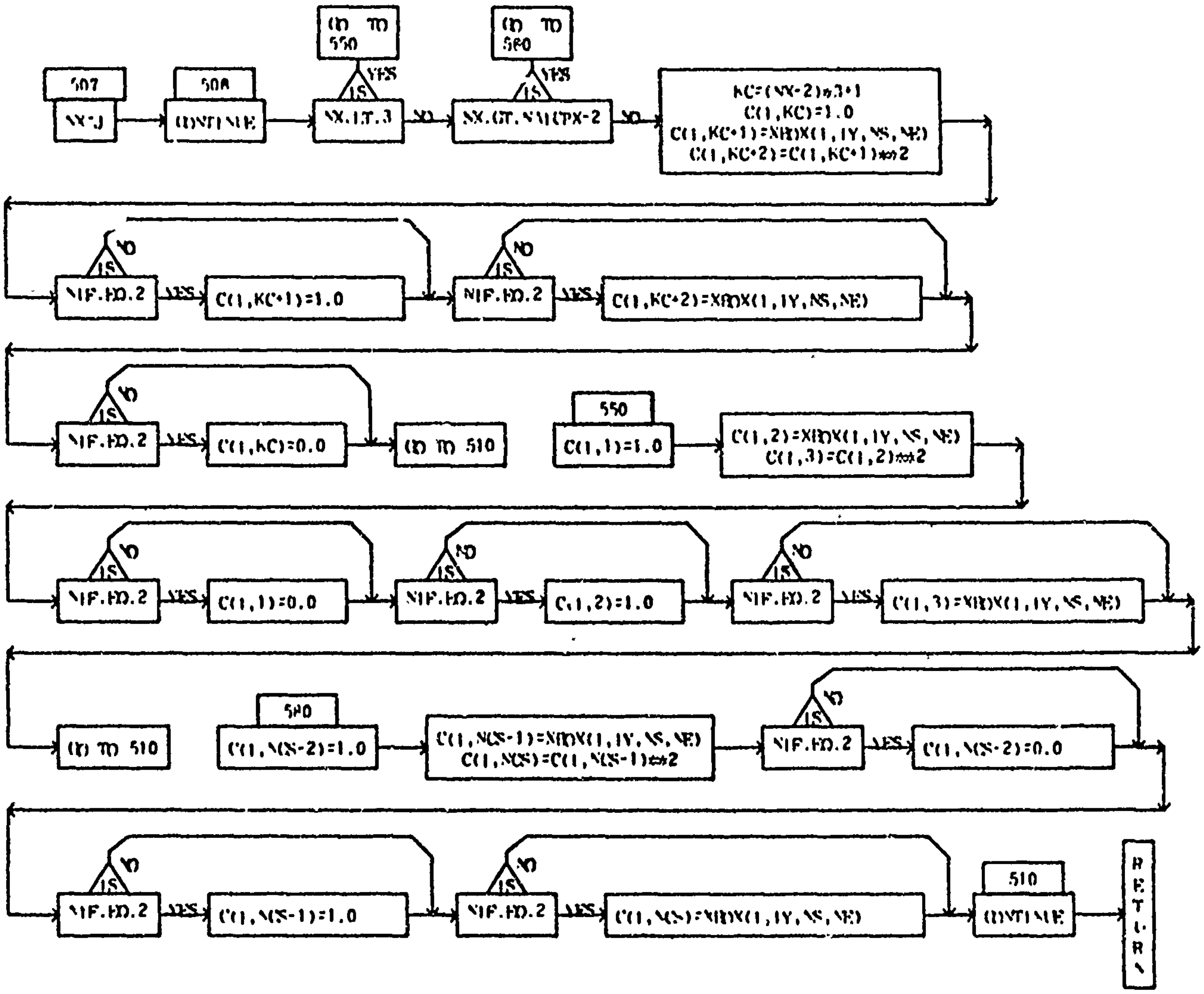
পেশা

DIMENSIONED VARIABLES

SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
C	45,45								


START
GO TO 3
YES
IS
NO
REPEAT TO 1
FOR
1
C(I,J)=0.0
GO TO 100
3
4
C(I,J)=0.0
100
CONTINUE
GO TO 500
GO TO 400
NCS.EQ.6
COMPUTED GO TO
IF THE VALUE OF NCS IS
TRANSFER TO STATEMENT
1 200
2 200
3 300
200
REPEAT TO 210
C(I,1)=1.0
C(I,1)=0.0
C(I,2)=1.0
210
CONTINUE
RETURN
300
REPEAT TO 310


310
CONTINUE
RETURN
400
REPEAT TO 410
FOR
I=1,I+1,...,NRS
GO TO
407
406
CONTINUE
407
408
KC=1
NX.GT.2
KC=4
C(I,KC)=1.0
NIF.EQ.2
C(I,KC)=0.0
C(I,KC+1)=1.0
410
CONTINUE
RETURN
500
REPEAT TO 510
FOR
I=1,I+1,...,NRS
GO TO
507
506
CONTINUE

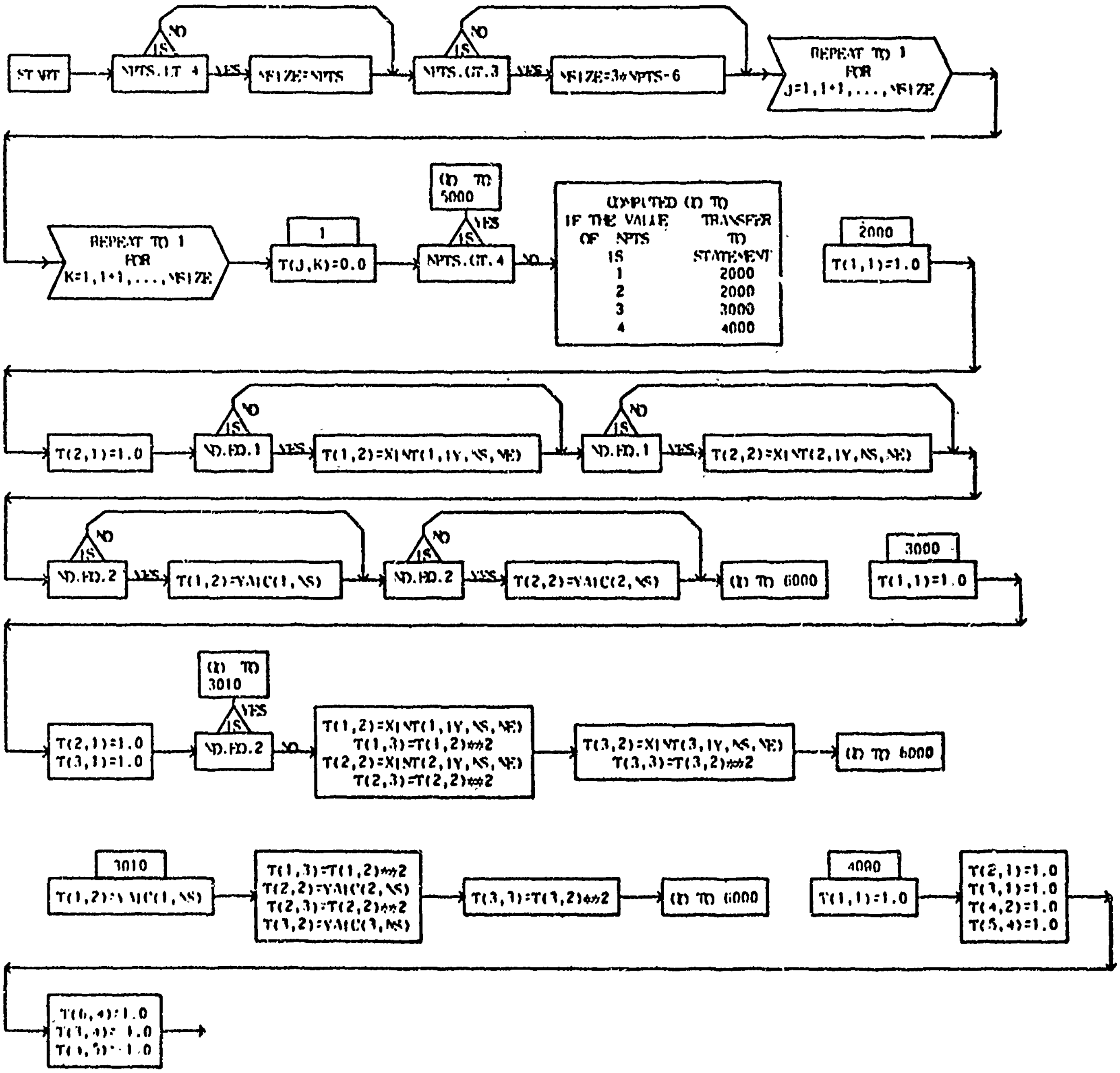

507
NX=3
508
CONTINUE
IS NX.LT.3
YES
GO TO 550
NO
IS NX.GT.NAICPX-2
YES
GO TO 580
NO
KC=(NX-2)*3+1
C(1,KC)=1.0
C(1,KC+1)=XBOX(1,IY,NS,NE)
C(1,KC+2)=C(1,KC+1)**2
IS NIF.EQ.2
YES
NO
C(1,KC+1)=1.0
C(1,KC+2)=XBOX(1,IY,NS,NE)
C(1,KC)=0.0
GO TO 510
550
C(1,1)=1.0
C(1,2)=XBOX(1,IY,NS,NE)
C(1,3)=C(1,2)**2
C(1,1)=0.0
C(1,2)=1.0
C(1,3)=XBOX(1,IY,NS,NE)
GO TO 510
580
C(1,NCS-2)=1.0
C(1,NCS-1)=XBOX(1,IY,NS,NE)
C(1,NCS)=C(1,NCS-1)**2
C(1,NCS-2)=0.0
C(1,NCS-1)=1.0
C(1,NCS)=XBOX(1,IY,NS,NE)
510
CONTINUE
RETURN

[illegible]

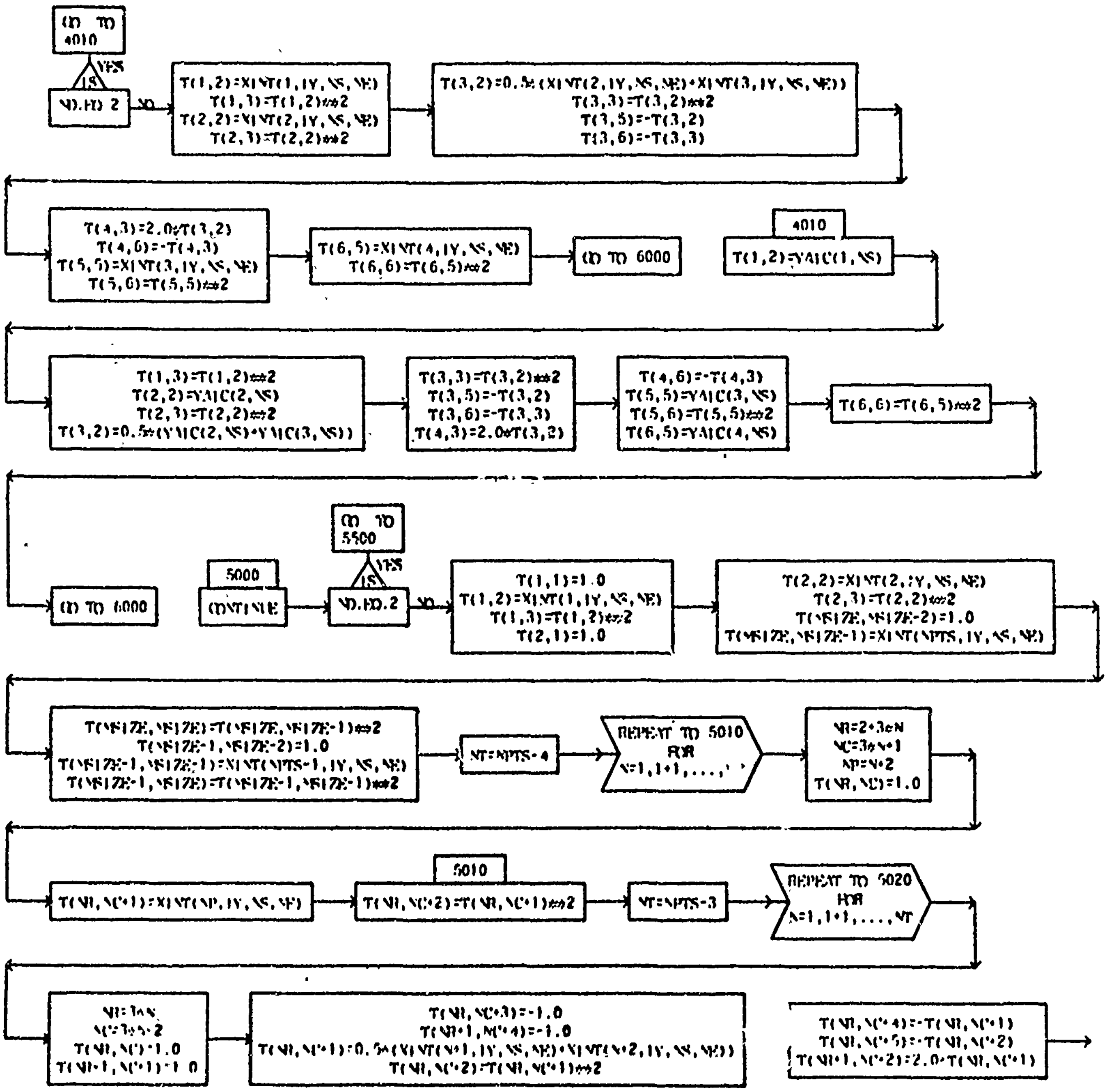
DIMENSIONED VARIABLES

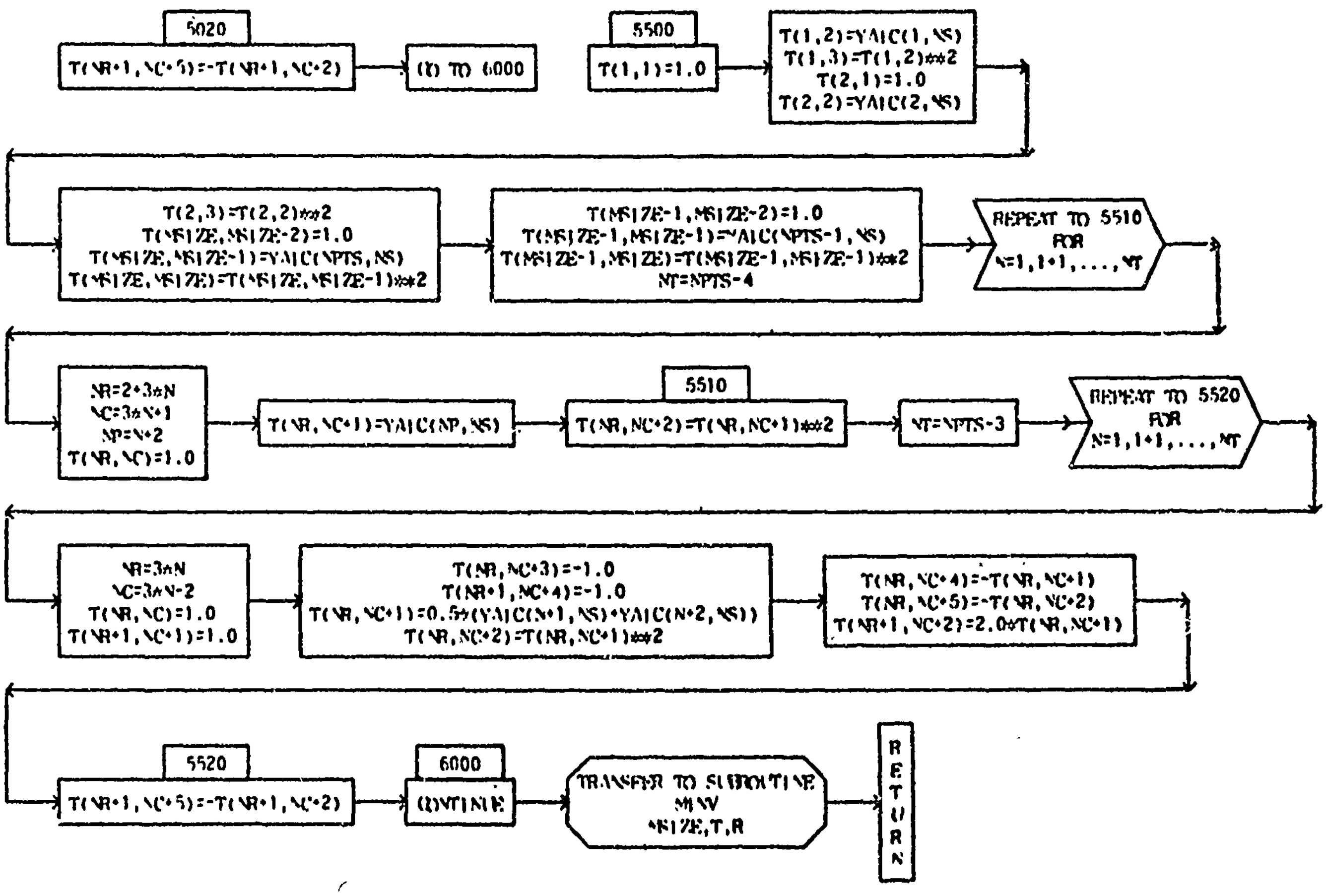
SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
T	45,45	B	45,45						

SUBROUTINE TMAT (NPTS,ND,NS,IY,NSIZE,NE,T,R) PAGE 1

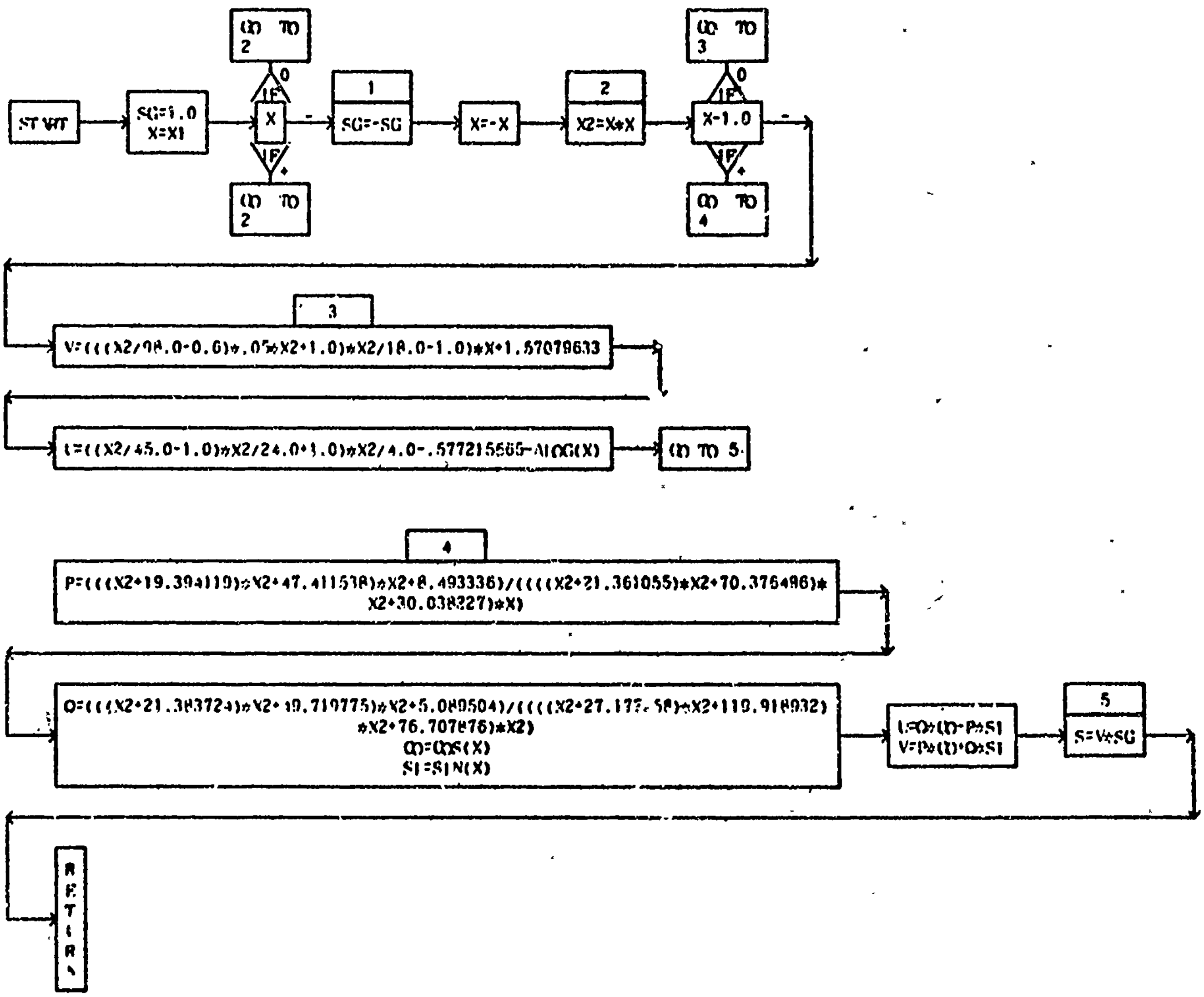


NOT REPRODUCIBLE





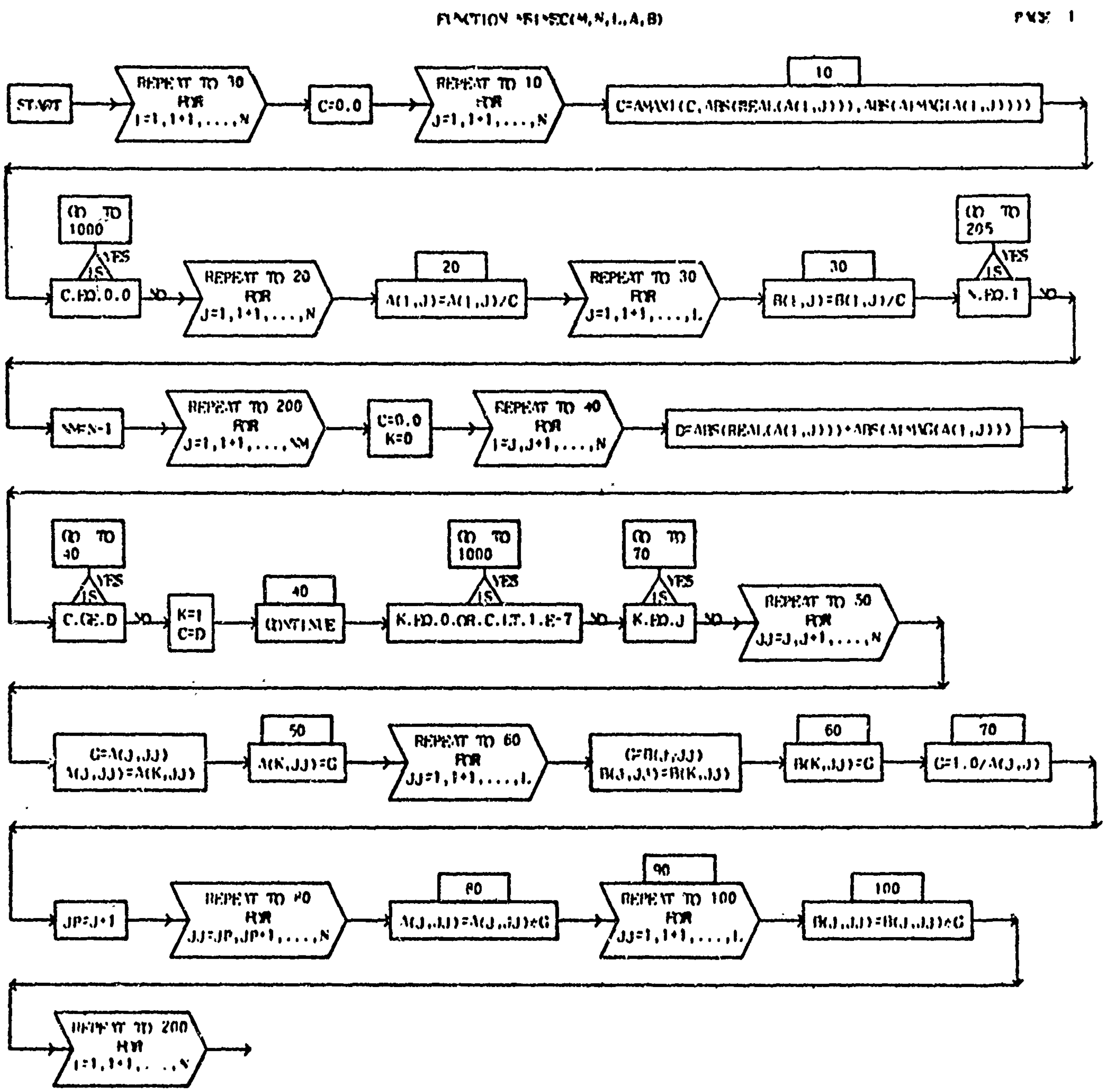
5020
T(NR+1,NC+5)=-T(NR+1,NC+2)
GO TO 6000
5500
T(1,1)=1.0
T(1,2)=YAIC(1,NS)
T(1,3)=T(1,2)**2
T(2,1)=1.0
T(2,2)=YAIC(2,NS)
T(2,3)=T(2,2)**2
T(MSIZE,MSIZE-2)=1.0
T(MSIZE,MSIZE-1)=YAIC(NPTS,NS)
T(MSIZE,MSIZE)=T(MSIZE,MSIZE-1)**2
T(MSIZE-1,MSIZE-2)=1.0
T(MSIZE-1,MSIZE-1)=YAIC(NPTS-1,NS)
T(MSIZE-1,MSIZE)=T(MSIZE-1,MSIZE-1)**2
NT=NPTS-4
REPEAT TO 5510
FOR
N=1,1+1,....,NT
NR=2+3*N
NC=3*N+1
NP=N+2
T(NR,NC)=1.0
T(NR,NC+1)=YAIC(NP,NS)
5510
T(NR,NC+2)=T(NR,NC+1)**2
NT=NPTS-3
REPEAT TO 5520
FOR
N=1,1+1,....,NT
NR=3*N
NC=3*N-2
T(NR,NC)=1.0
T(NR+1,NC+1)=1.0
T(NR,NC+3)=-1.0
T(NR+1,NC+4)=-1.0
T(NR,NC+1)=0.5*(YAIC(N+1,NS)+YAIC(N+2,NS))
T(NR,NC+2)=T(NR,NC+1)**2
T(NR,NC+4)=-T(NR,NC+1)
T(NR,NC+5)=-T(NR,NC+2)
T(NR+1,NC+2)=2.0*T(NR,NC+1)
5520
T(NR+1,NC+5)=-T(NR+1,NC+2)
6000
CONTINUE
TRANSFER TO SUBROUTINE
MINV
MSIZE,T,R
RETURN

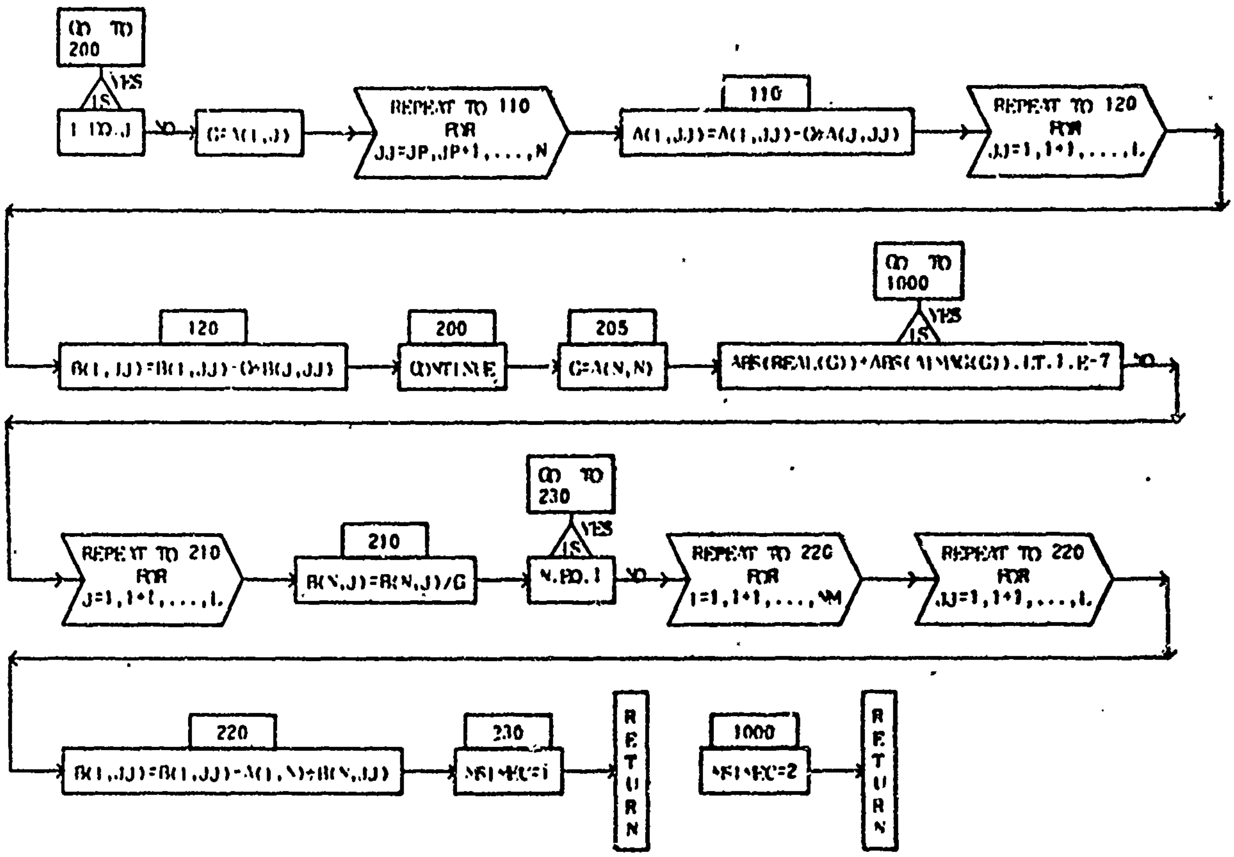

START
SG=1.0
X=X1
IF X
GO TO 2
GO TO 2
1
SG=-SG
X=-X
2
X2=X*X
IF X-1.0
GO TO 3
GO TO 4
3
V=(((X2/98.0-0.6)*.05*X2+1.0)*X2/18.0-1.0)*X+1.57079633
U=((X2/45.0-1.0)*X2/24.0+1.0)*X2/4.0-.577215665-ALOG(X)
GO TO 5
4
P=(((X2+19.394119)*X2+47.411538)*X2+8.493336)/((((X2+21.361055)*X2+70.376496)*X2+30.038227)*X)
Q=(((X2+21.383724)*X2+19.719775)*X2+5.089504)/((((X2+27.177558)*X2+119.918932)*X2+76.707876)*X2)
CO=COS(X)
SI=SIN(X)
U=Q*CO-P*SI
V=P*CO+Q*SI
5
S=V*SG
RETURN

DIMENSIONED VARIABLES

SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE
A	M,1	B	M,1						

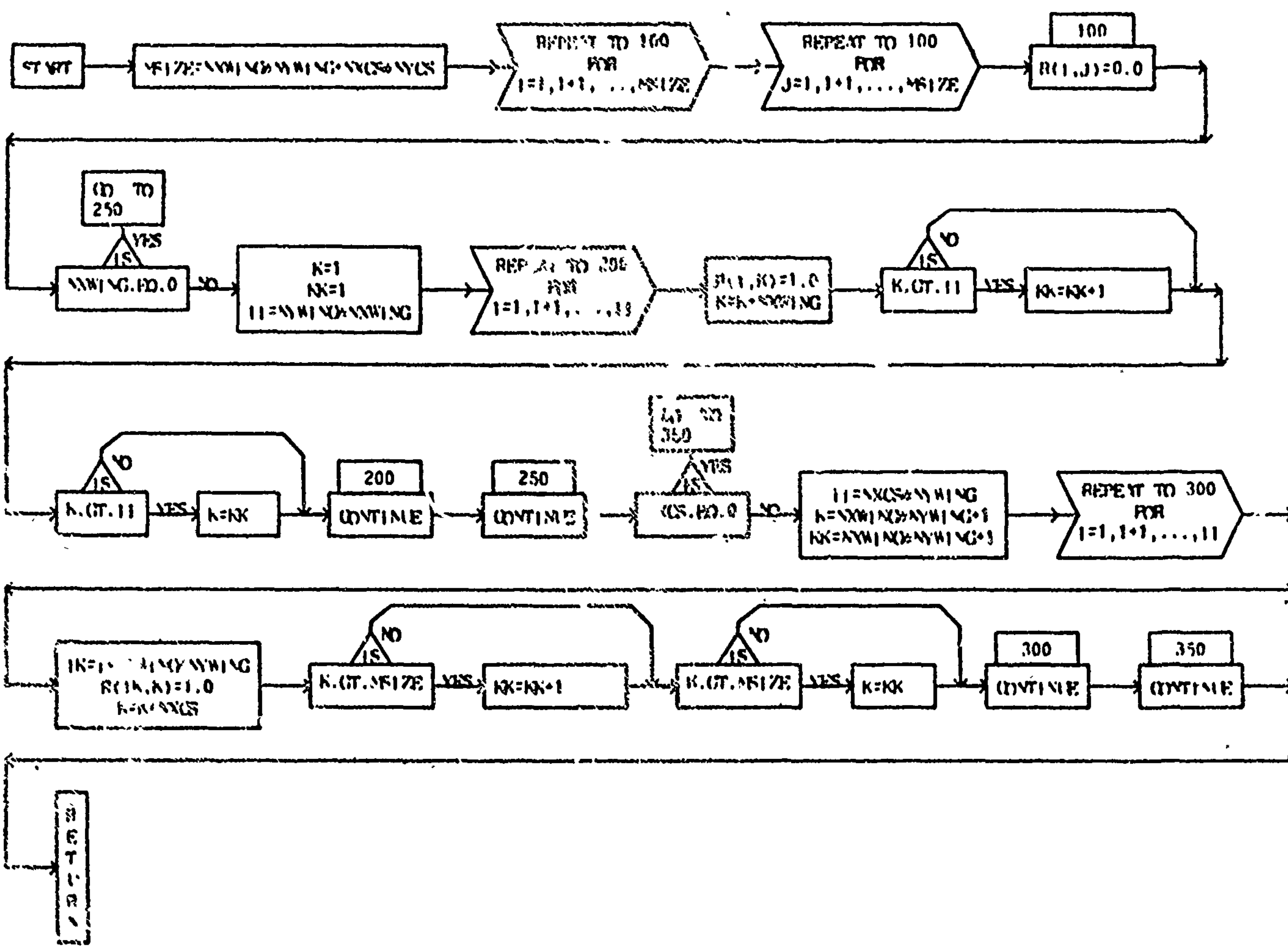
NOT REPRODUCIBLE



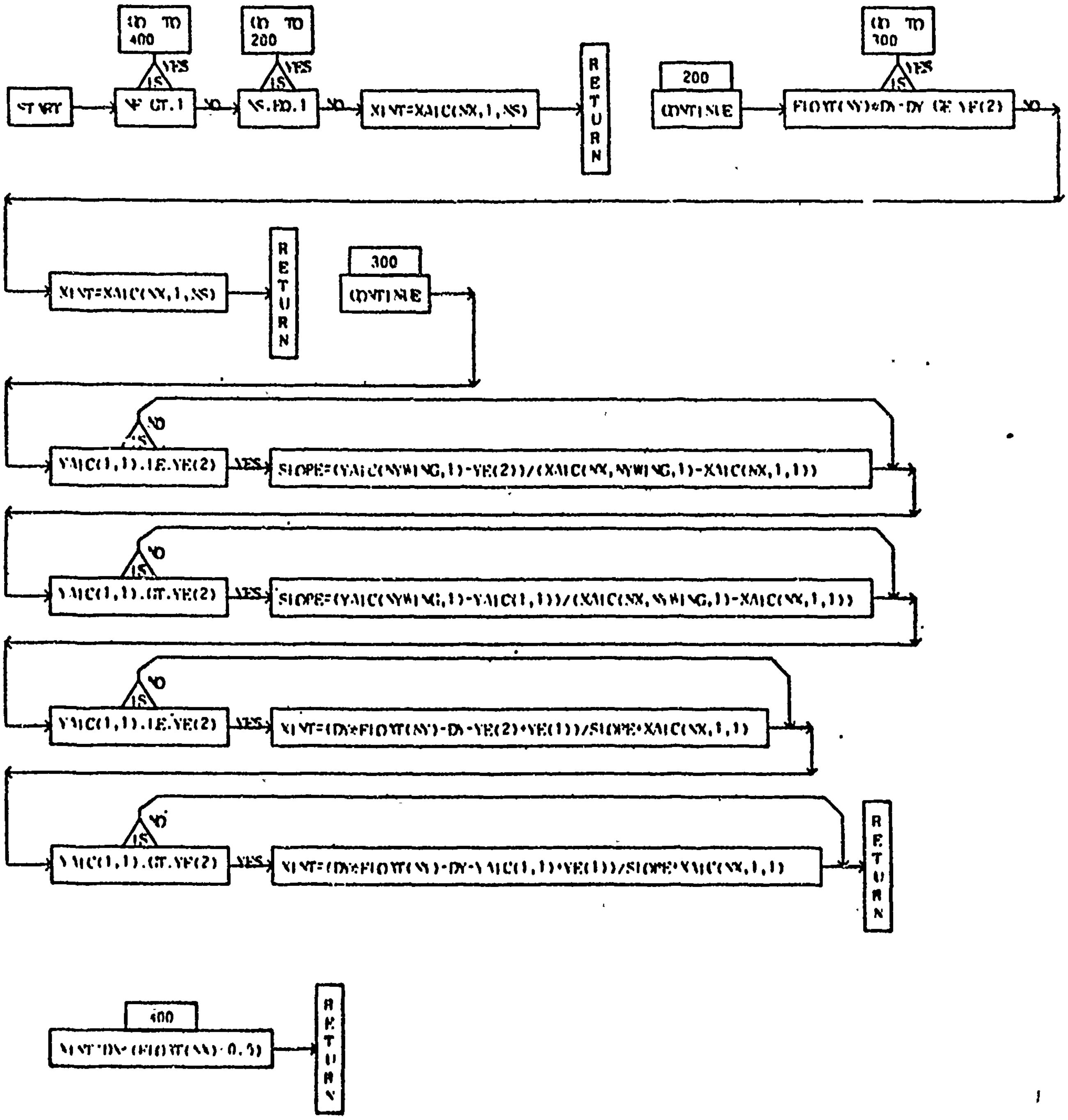

GO TO 200
YES
IS
I EQ.J
NO
G=A(I,J)
REPEAT TO 110 FOR JJ=JP,JP+1,...,N
110
A(I,JJ)=A(I,JJ)-G*A(J,JJ)
REPEAT TO 120 FOR JJ=1,1+1,...,L
120
B(I,JJ)=B(I,JJ)-G*B(J,JJ)
200
CONTINUE
205
G=A(N,N)
GO TO 1000
ABS(REAL(G))+ABS(AIMAG(G)).LT.1.E-7
REPEAT TO 210 FOR J=1,1+1,...,L
210
B(N,J)=B(N,J)/G
GO TO 230
N.EQ.1
REPEAT TO 220 FOR I=1,1+1,...,NM
REPEAT TO 220 FOR JJ=1,1+1,...,L
220
B(I,JJ)=B(I,JJ)-A(I,N)*B(N,JJ)
230
MSIMEC=1
RETURN
1000
MSIMEC=2
RETURN

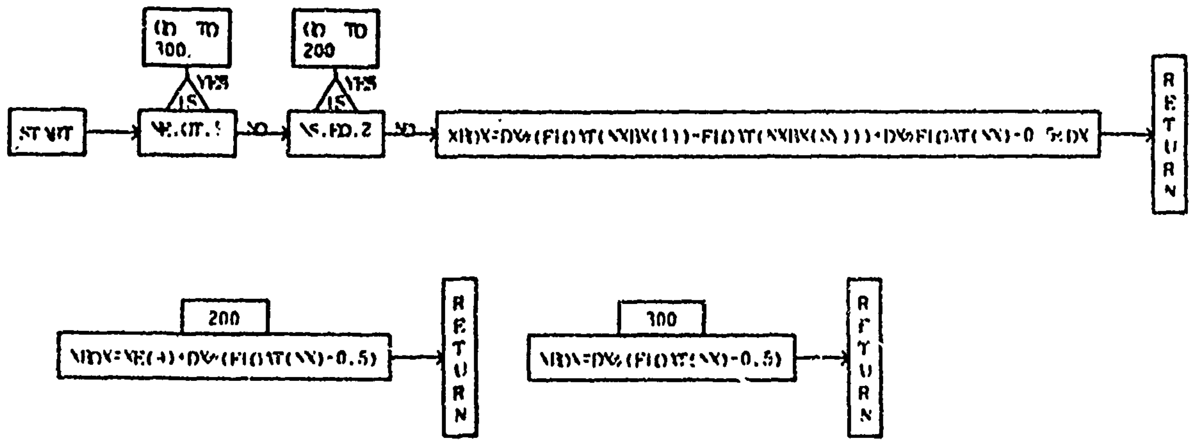
DIMENSIONED VARIABLES

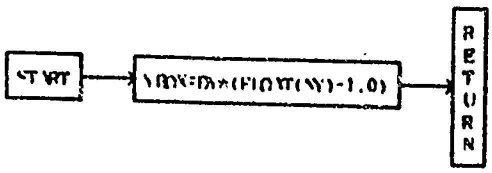
SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
R	45,45								


START
MSIZE=NXWING*NYWING+NXCS*NYCS
REPEAT TO 100 FOR I=1,1+1,...,MSIZE
REPEAT TO 100 FOR J=1,1+1,...,MSIZE
100
B(I,J)=0.0
GO TO 250
YES
IS
NXWING.EQ.0
NO
K=1
KK=1
II=NXWING*NXWING
REPEAT TO 200 FOR I=1,1+1,...,II
B(I,K)=1.0
K=K+NXWING
NO
IS
K.GT.II
YES
KK=KK+1
NO
IS
K.GT.II
YES
K=KK
200
CONTINUE
250
CONTINUE
GO TO 350
YES
IS
NCS.EQ.0
NO
II=NXCS*NYWING
K=NXWING*NYWING+1
KK=NXWING*NYWING+1
REPEAT TO 300 FOR I=1,1+1,...,II
B(IK,K)=1.0
K=K+NXCS
NO
IS
K.GT.MSIZE
YES
KK=KK+1
NO
IS
K.GT.MSIZE
YES
K=KK
300
CONTINUE
350
CONTINUE
RETURN

XIV


START
GO TO 400
YES
IS
NO
GO TO 200
NS.EQ.1
XINT=XALC(NX,1,NS)
RETURN
200
CONTINUE
GO TO 300
XINT=XALC(NX,1,NS)
RETURN
300
CONTINUE
YALC(1,1).LE.YE(2)
SLOPE=(YALC(NYWING,1)-YE(2))/(XALC(NX,NYWING,1)-XALC(NX,1,1))
YALC(1,1).GT.YE(2)
YALC(1,1).LE.YE(2)
YALC(1,1).GT.YE(2)
RETURN
400
RETURN

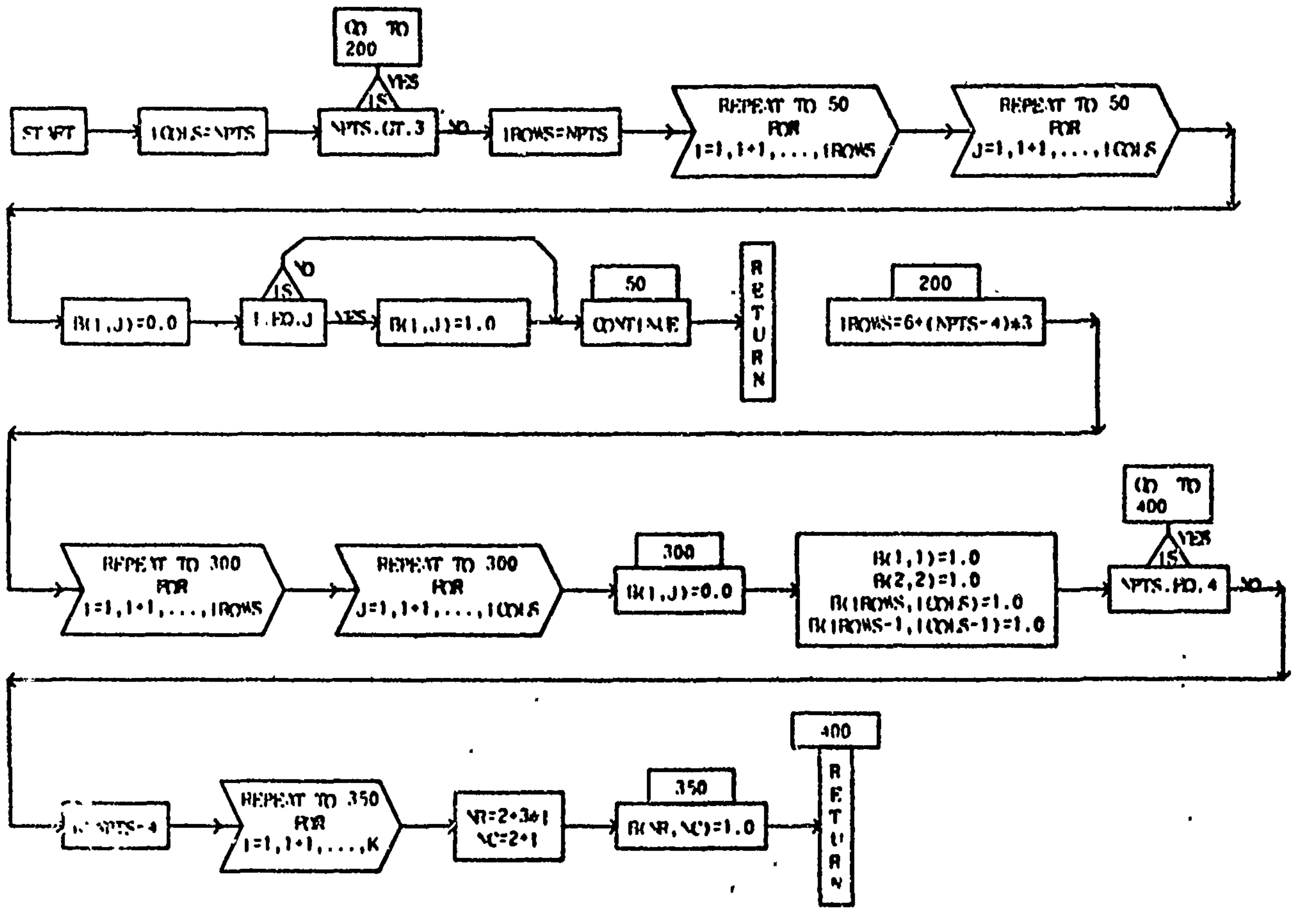

GO TO 300.
GO TO 200
YES
IS
NO
RETURN
200
300


START
VBOX=DY*(FLOAT(NY)-1.0)
RETURN

सिमरा

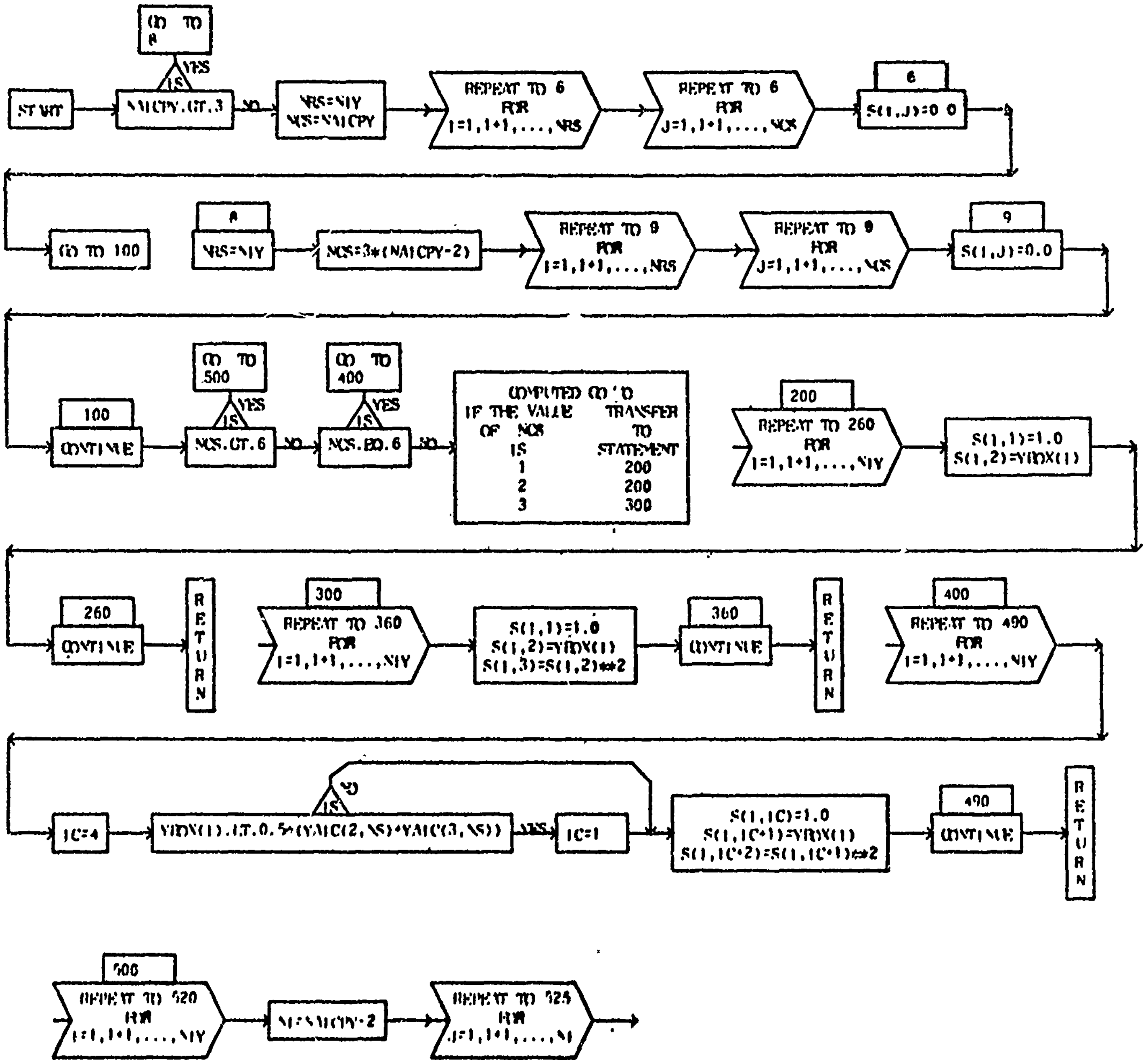
DIMENSIONED VARIABLES

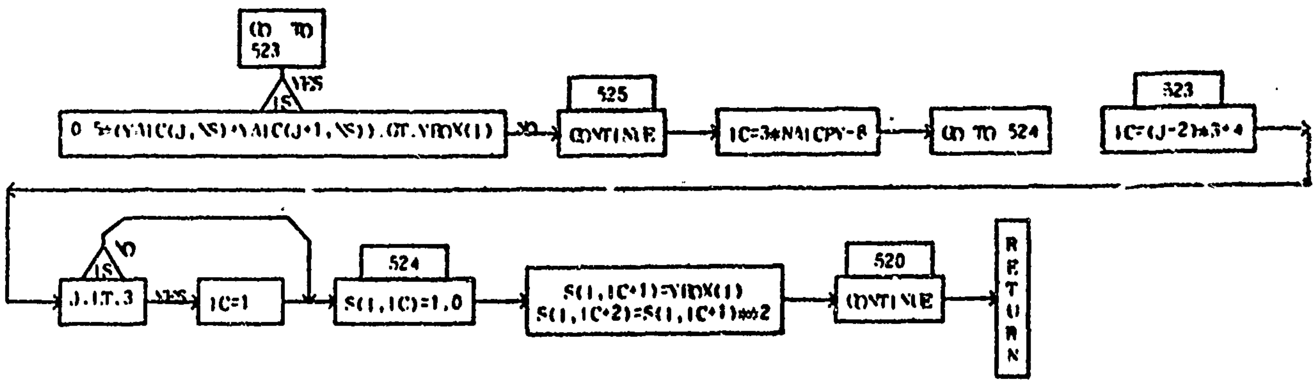
SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
B	45,45								


START
ICOLS=NPTS
GO TO 200
YES
IS
NPTS.GT.3
NO
IROWS=NPTS
REPEAT TO 50 FOR I=1,I+1,...,IROWS
REPEAT TO 50 FOR J=1,I+1,...,ICOLS
B(I,J)=0.0
NO
IS
I.EQ.J
YES
B(I,J)=1.0
50
CONTINUE
RETURN
200
IROWS=6+(NPTS-4)*3
REPEAT TO 300 FOR I=1,I+1,...,IROWS
REPEAT TO 300 FOR J=1,I+1,...,ICOLS
300
B(I,J)=0.0
B(1,1)=1.0
B(2,2)=1.0
B(IROWS,ICOLS)=1.0
B(IROWS-1,ICOLS-1)=1.0
GO TO 400
YES
IS
NPTS.EQ.4
NO
REPEAT TO 350 FOR I=1,I+1,...,K
NR=2+3*I
NC=2+I
350
B(NR,NC)=1.0
400
RETURN

DIMENSIONED VARIABLES

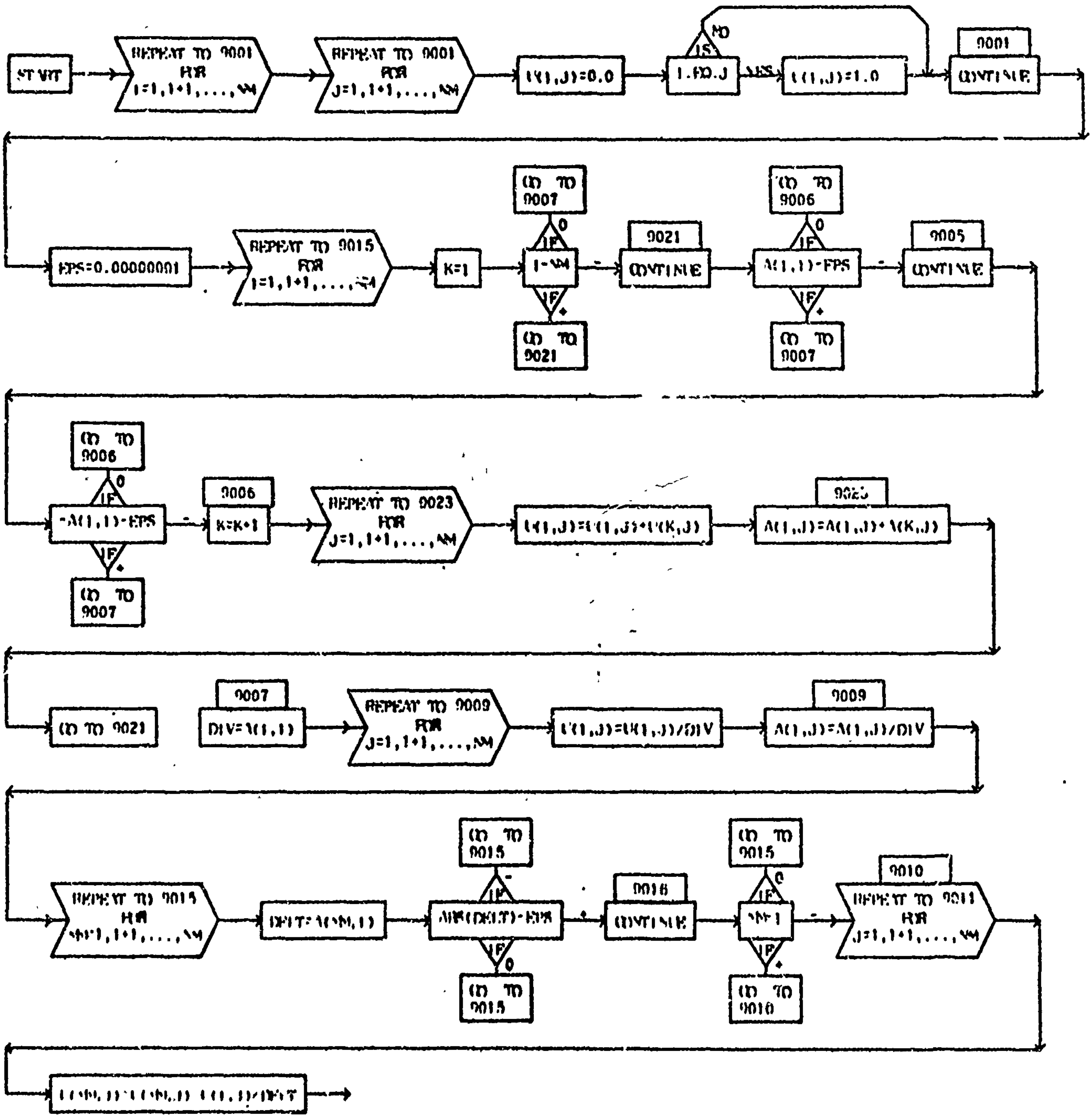
SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
S	45,45								

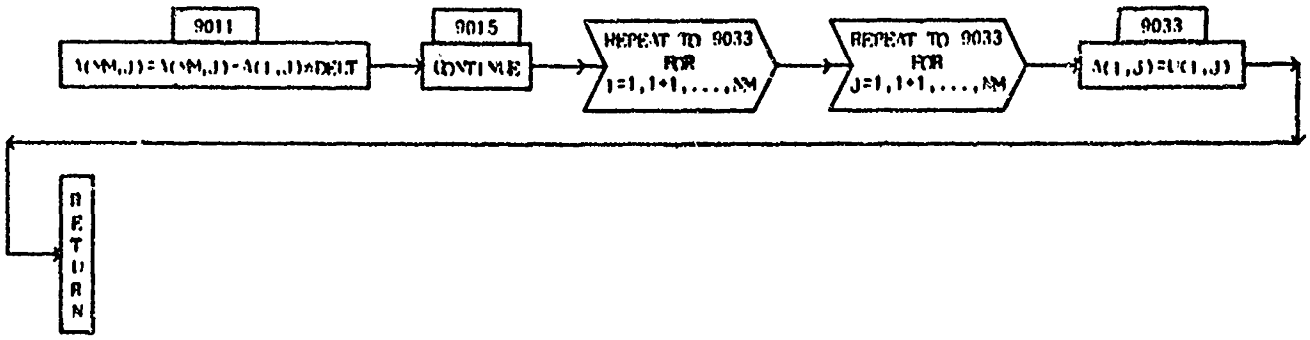

START
GO TO 8
YES
IS
NAICPY.GT.3
NO
NRS=NIY
NCS=NAICPY
REPEAT TO 6
FOR
I=1,1+1,...,NRS
REPEAT TO 6
FOR
J=1,1+1,...,NCS
6
S(I,J)=0.0
GO TO 100
8
NRS=NIY
NCS=3*(NAICPY-2)
REPEAT TO 9
FOR
I=1,1+1,...,NRS
REPEAT TO 9
FOR
J=1,1+1,...,NCS
9
S(I,J)=0.0
100
CONTINUE
GO TO 500
NCS.GT.6
GO TO 400
NCS.EQ.6
COMPUTED GO TO
IF THE VALUE OF NCS IS
TRANSFER TO STATEMENT
1 200
2 200
3 300
200
REPEAT TO 260
FOR
I=1,1+1,...,NIY
S(I,1)=1.0
S(I,2)=YBOX(I)
260
CONTINUE
RETURN
300
REPEAT TO 360
FOR
I=1,1+1,...,NIY
S(I,1)=1.0
S(I,2)=YBOX(I)
S(I,3)=S(I,2)**2
360
CONTINUE
RETURN
400
REPEAT TO 490
FOR
I=1,1+1,...,NIY
IC=4
YBOX(I).LT.0.5*(YAIC(2,NS)+YAIC(3,NS))
IC=1
S(I,IC)=1.0
S(I,IC+1)=YBOX(I)
S(I,IC+2)=S(I,IC+1)**2
490
CONTINUE
RETURN
500
REPEAT TO 520
FOR
I=1,1+1,...,NIY
NS=NAICPY-2
REPEAT TO 525
FOR
J=1,1+1,...,NS


GO TO 523
YES
IS
0.5*(YAIC(J,NS)+YAIC(J+1,NS)).GT.YBOX(I)
NO
525
CONTINUE
IC=3*NAICPY-8
GO TO 524
523
IC=(J-2)*3+4
IS
NO
J.LT.3
YES
IC=1
524
S(I,IC)=1.0
S(I,IC+1)=YBOX(I)
S(I,IC+2)=S(I,IC+1)**2
520
CONTINUE
RETURN

DIMENSIONED VARIABLES

SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE
A	45,45	U	45,45						


START
REPEAT TO 9001 FOR I=1,I+1,...,NM
REPEAT TO 9001 FOR J=1,1+1,...,NM
9001
CONTINUE
EPS=0.00000001
REPEAT TO 9015 FOR I=1,I+1,...,NM
K=1
GO TO 9007
GO TO 9021
9021
CONTINUE
GO TO 9006
9005
CONTINUE
9006
K=K+1
REPEAT TO 9023 FOR J=1,1+1,...,NM
GO TO 9021
9007
REPEAT TO 9009 FOR J=1,1+1,...,NM
9009
GO TO 9015
9016
CONTINUE
GO TO 9016
9010


9011
A(NM,J)=A(NM,J)-A(I,J)*DELT
9015
CONTINUE
REPEAT TO 9033
FOR
I=1,I+1,...,NM
REPEAT TO 9033
FOR
J=1,I+1,...,NM
9033
A(I,J)=U(I,J)
RETURN

PART VI - SECTION A

TECHNICAL DISCUSSION OF THE SUPERSONIC BOX METHOD

The linearized flow equation is in the form of a hyperbolic differential equation when the flight speed exceeds the speed of sound. The supersonic version

$$\beta^2 \Phi_{xx} - \Phi_{yy} - \Phi_{zz} = -M^2 \left[2ik\,\Phi_x - k^2\Phi\right] \qquad (6.1)$$

where $\beta^2 = M^2 - 1$, has solutions only within characteristic regions, called Mach cones. Linearized supersonic flow theory has led to closed-form solutions for many types of lifting surfaces in steady flow (Reference 11), such as the rectangular wing, delta wing, and trapezoidal wing. These solutions are derived easily because the influence of a small perturbation is confined to its downstream or aft Mach cone. Conversely, the only disturbances that can influence a particular point are confined to its upstream or fore Mach cone.

The most elementary disturbance that can be placed in the flow and that is a solution to Equation (6.1) is the pulsating source. The source, placed at (ξ, η, ζ) emanates spherical disturbances and has a velocity potential induced at x, y, z, given by

$$\phi_s = A(\xi, \eta, \zeta)\, G(x-\xi,\, y-\eta,\, z-\zeta)$$

$$G(x-\xi,\, y-\eta,\, z-\zeta) = -\frac{1}{\pi R} \exp\left[-i\bar{k}(x-\xi)\right] \cos\left[\frac{\bar{k}}{M} R\right] \qquad (6.2)$$

where

$R = \sqrt{(x-\xi)^2 - \beta^2\left[(y-\eta)^2 + (z-\zeta)^2\right]}$, $\bar{k} = k M^2/\beta^2$, and $A(\xi, \eta, \zeta)$

represents the strength of the source. This type of disturbance has no influence outside the downstream Mach cone and is discontinuous at the point (ξ, η, ζ). To provide the necessary antisymmetry of disturbances with the symmetric source solution, we could place a pair of sources on either side of the z = 0 plane and require the lower source strength to be equal in magnitude and opposite in sense if we could isolate the lower from the upper half space. Since disturbances are confined to Mach cones, this isolation is possible if the entire region of disturbances in the z = 0 plane is covered with two source sheets placed on both sides with the distance between them infinitesimally small.

Applying this source-superposition technique to the wing and downstream control surface problem requires constructing for the configuration a Mach envelope that contains all possible disturbances. The entire z = 0 plane within that boundary is covered with source sheets immediately above and below the plane. A typical configuration with foremost and aftmost Mach cone intercepts with the z = 0 plane is shown in Figure 6.1.

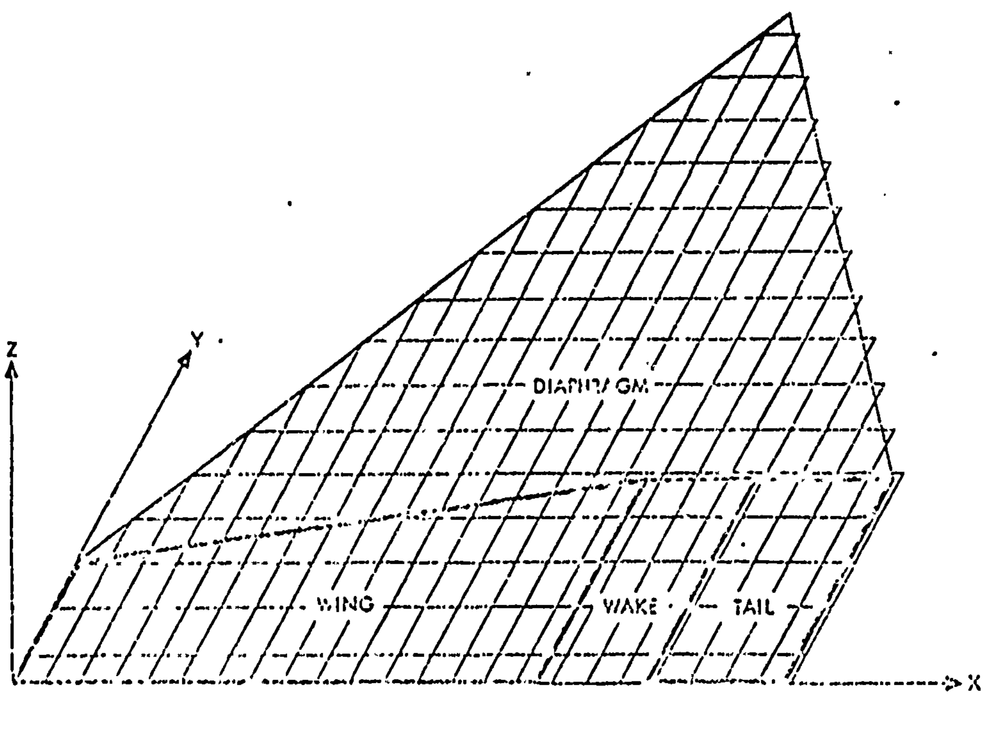


FIGURE 6.1 - SUPERSONIC BOX OVERLAY FOR A TYPICAL CONFIGURATION AT LOW SUPERSONIC MACH NUMBER

The strength distribution over the bottom sheets is to be equal at adjacent points but opposite in sense,

$$A(\xi, \eta, o^+) = -A(\xi, \eta, o^-) \tag{6.3}$$

and determined by boundary conditions so that loading acts only on regions superposed over lifting surfaces. This strength distribution has been shown (Reference 12) to be equal everywhere to the local downwash. When this conditon is used, $A(\xi, \eta, o^+) = w(\xi, \eta, o^+)$, the velocity potential at (x, y, o^+) can be written as

$$\phi = \iint w(\xi, \eta)\, G\,(x - \xi, y - \eta)\, d\xi\, d\eta \tag{6.4}$$

where the range of integration extends over the region of the source sheet contained in the upstream Mach cone from the point. Substitution of the tangential flow condition for the downwash would yield a solvable integral equation if the source sheet covered only a lifting surface. Such is not the case when the Mach number normal to any swept edge is subsonic.

The downwash distribution between any subsonic edge and the Mach envelope (diaphragm) can be determined (Reference 13) by simply satisfying the condition that the pressure is continuous between any two adjacent field points that are not on opposite sides of a lifting surface. If no disturbances lie upstream along the line, y = constant, z = constant, then the velocity potential will also be continuous and the linearized pressure-velocity potential relation yields the condition that

$$\phi(x, y, o^+) - \phi(x, y, o^-) = 0$$

which leads to

$$\phi(x, y, o^+) = \phi(x, y, o^-) = 0 \tag{6.5}$$

when the antisymmetric condition that the upper potential equals minus the lower potential is applied. The downwash in the diaphragm region can then be evaluated by the integral equation

$$o = \iint w\,(\xi,\eta)\;\; G\;\;(x-\xi\,,\;y-\eta)\;d\xi\;d\eta \qquad (6.6)$$

which has been solved for special cases (Reference 13).

The downwash distribution in the wake region can also be determined by satisfaction of the continuous pressure condition. In this case the potential has a non-zero constant value at (x, y). Substitution of the wake condition,

$$\phi_{wake} = \phi_{TE}\;\exp\;\;-ik(x-x_{TE}) \qquad (6.7)$$

into Equation (6.4) provides the relationship

$$\phi_{W_{TE}}\left[\exp\;-ik\left(x-x_{W_{TE}}\right)\right] = \iint w\;(\xi,\eta)G\;(x-\xi,\;y-\eta)\;d\xi\;d\eta \qquad (6.8)$$

which requires knowledge of the upstream downwash distribution within the fore Mach cone to solve for the local wake downwash.

Computation of the downwash (source strength) distribution over the entire disturbance region and subsequent velocity potential distribution over the lifting surfaces for any supersonic Mach number and any non-negative reduced frequency for configurations of interest can be accomplished if the method developed in Reference 14 and extended in Reference 3 is followed. We cover the region of disturbances with a grid of rectangular boxes of length Δ and width Δ/β adjusted so that box edges lie along the y-axis and box centers lie along the x-axis and wing trailing edge. The box width is determined so that the box diagonals are parallel with Mach lines, hence the name Mach box. The configuration used in this development is shown in Figure 3 with Mach boxes covering the wing, wake, tail, and diaphragm regions. Boxes are in each of these regions according to the location of their respective centers.

Consider the downwash or source strength distribution to be approximated by a set of point values determined by satisfying the appropriate boundary conditions at box centers. When each central value is considered constant over its associated box, the velocity potential at any box center can be computed from

$$\phi_{n,m} = \sum_{\nu} \sum_{\mu} w_{\nu,\mu} \, \phi(n - \nu, \; |m - \mu|) \tag{6.9}$$

where $n = x/\Delta$, $m = \beta y/\Delta$, $\nu = \xi/\Delta$, $\mu = \beta\eta/\Delta$ are box center coordinates. The influence coefficients (IC) are given by

$$\phi(n - \nu, \; |m - \mu|) = \iint\limits_{\substack{\text{BOX}\\ \text{AREA}}} G(n - \nu, \; m - \mu) \, d\xi \, d\eta \tag{6.10}$$

where the unit source potential, G, is integrated over that portion of the box area at (ν, μ) that is within the fore Mach cone from the box center at (n, m). Methods of evaluation of the IC for each pair of relative box locations at a particular Mach number and reduced frequency are presented in Reference 3.

Equation (6.9) is applied to the boxes one at a time beginning at the center box in the first row, then proceeding outward. After completing the first row, the same procedure is followed in the second row, etc. In following this procedure, it is found that there exists only one unknown in each box, since all of the upstream quantities except those in the box being computed will be available. This advantage is obtained because of the use of Mach boxes wherein the forward integration cone from the box center will not include any areas from the same row. Then in evaluating Equation (6.9) it follows that only $\phi_{n,m}$ and $W_{n,m}$ are unknown, and one may then write

$$\phi_{n,m} - w_{n,m} \, \Phi(0, 0) = \sum_{\nu > n} \sum_{\mu > m} w_{\nu,\mu} \, \Phi(n - \nu, \; |m - \mu|) \tag{6.11}$$

where $\Phi(o, o)$ as is indicated in Equation (6.10) represents the integral of G over the forward quarter of the Mach box. This relationship has all the upstream influence represented on the right side and the total minus the local velocity potential on the left side.

Any box on either surface has its downwash given by the tangential flow condition and its velocity potential given by Equation (6.11). $\phi_{n,m}$ can then be determined from this equation.

Boxes entirely in the diaphragm region have zero velocity potential and the source strength is then determined by

$$w_{n,m} = - \frac{1}{\Phi(o, o)} \sum_{\nu > n} \sum_{\mu > m} w_{\nu,\mu} \, \Phi(n - \nu, |m - \mu|) \qquad (6.12)$$

which is Equation (6.11) with $\phi_{n,m} = 0$. Any box that is intersected by a subsonic edge has its source strength modifed by a linear interpolation between the downwash at the box center computed as if it were first a surface box and then a diaphragm box (Reference 15). This interpolation is based on the proportion of the box area lying in the two regions. The downwash at the center of a wake box is computed by substituting Equation (6.7) into Equation (6.11) to obtain

$$w_{n,m} = - \frac{1}{\Phi(o, o)} \left\{ \phi_{W_{TE}} \exp\left[-ik(n - nW_{TE})\right] - \sum_{\nu > n} \sum_{\mu > m} w_{\nu,\mu} \Phi(n - \nu, |m - \mu|) \right\} \qquad (6.13)$$

where the velocity potential at the wing trailing edge ties in the same box column (m = constant) with the wake box of interest.

Utilizing the above equations for either downwash or velocity potential, we can build up the point value distribution of velocity potential for both surfaces deforming harmonically at the same frequency. The values at the wing trailing edge are at box centers, and the values at the tail leading and trailing edge may be computed by the method described in the previous section.

PART VI - SECTION B

SUPERSONIC AIC COMPUTER PROGRAM DESCRIPTION

A FORTRAN IV computer program is presented which computes supersonic unsteady aerodynamic influence coefficients for a variety of single or tandem lifting surfaces. The solution is based on the source superposition method and a Mach box approximation is employed to reduce the integral equations to sums of constant values of source strengths at box centers times integrals which are functions of relative position, Mach number and reduced frequency.

The various tandem configurations which can be analyzed are shown in Figure 6.2. Also it is possible to analyze a single surface (the wing). The aerodynamic surfaces are assumed to have a plane of symmetry parallel to the free stream flow. The upstream surface must have an unswept trailing edge and the rectangular trailing surface must have the same spanwise dimension as the trailing edge of the wing.

The program allows up to 40 AIC control points. The AIC stations must satisfy the following requirements:

(1) The chordwise rows must be parallel to the flow stream

(2) The chordwise rows on a surface must have the same number of control points

(3) The control points in each spanwise row must have the same fractional chordwise location

(4) The origin for the AIC station coordinates and the wing and control surface coordinates must be at the leading edge root of the wing.

Examples of acceptable AIC control point patterns for the supersonic program are illustrated in Figure 6.3.

The supersonic AIC program is presently limited to 45 boxes on the aerodynamic surfaces. This limitation does not include the diaphragm boxes in the gap and outboard region. The restriction results from performing all operations on the computer in core without utilizing peripheral tape and disc units.

The user specifies the number of boxes along the wing root and the computer program determines the size of the boxes and overlay pattern which will cover the planform. The box centers of the first chordwise row will lie along the root of the surfaces. The last spanwise row of boxes on the wing will have their centers on the trailing edge. If NBW is selected by the user as the number of chordwise boxes on the wing root and if the wing root dimension is $2b_r$, then

the box size will be $\Delta_c \times \Delta_s$ where $\Delta_c = 2b_r/(NBW-.5)$ and $\Delta_s = \Delta_c/\sqrt{M^2-1}$. Δ_c is the chordwise width and Δ_s is the spanwise box width. Knowing the size of the boxes and the planform geometry, the user can estimate if the 45 box restriction is satisfied. An example of a typical overlay is shown in Figure 6.4.

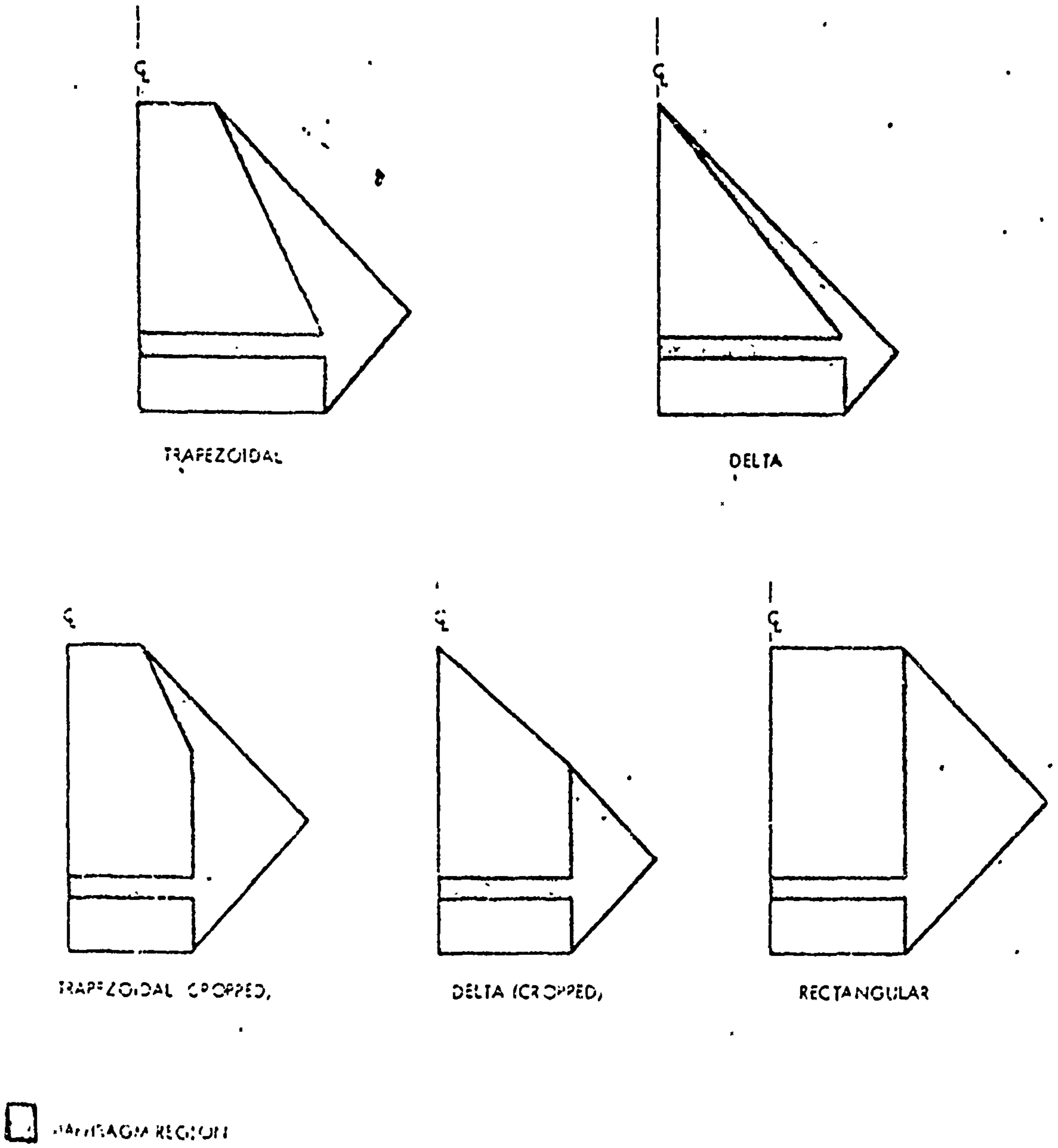


Figure 6.2 -

Tandem Coplanar Configurations at Supersonic Mach Number

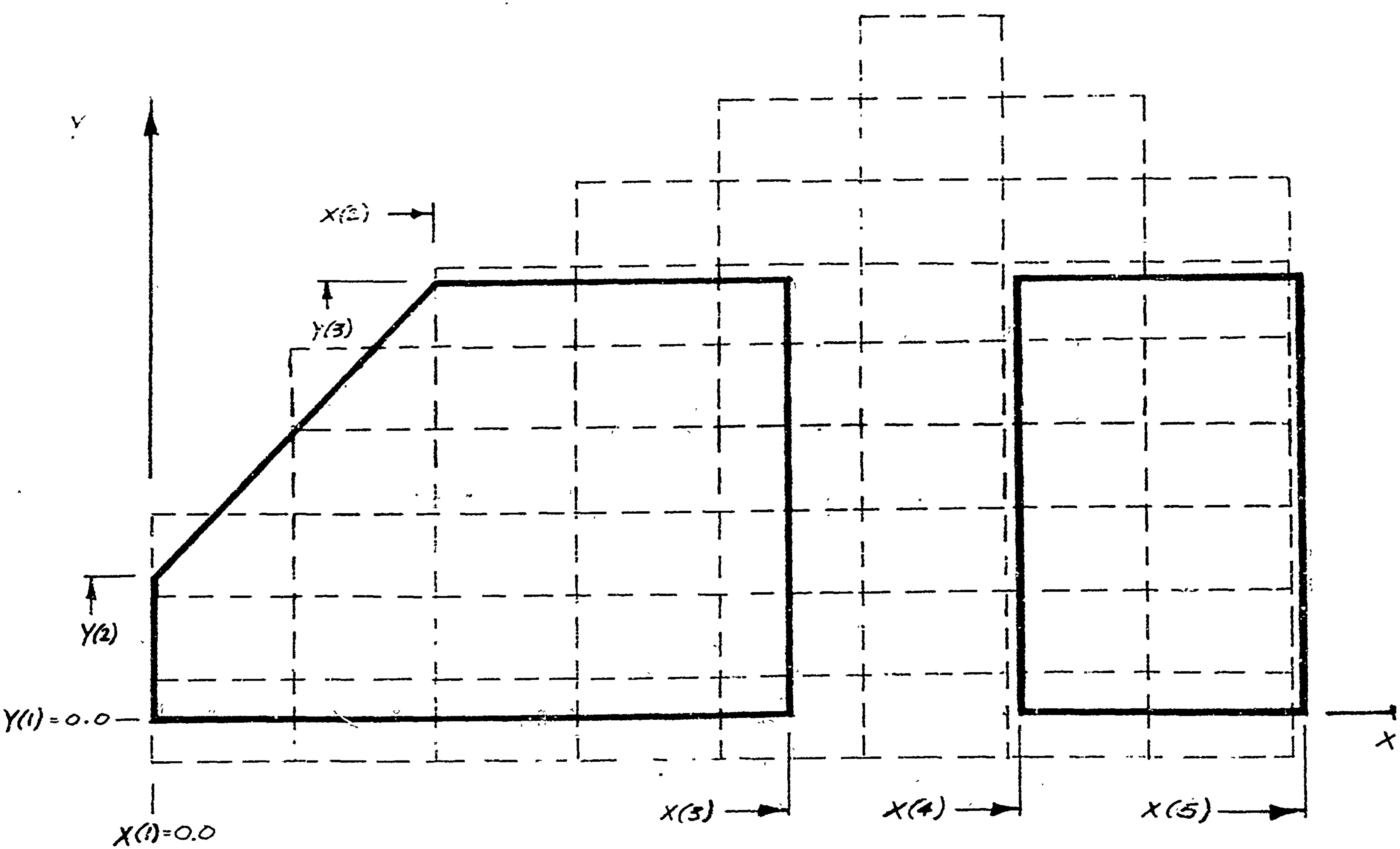


FIGURE 6.4 - GEOMETRIC DESCRIPTION AND SUPERSONIC BOX OVERLAY

The supersonic AIC computer program consists of a main program (DRIVE) and 20 subroutines and function subprograms. Execution begins with DRIVE calling DAIN which reads the input data. Control then passes to a Mach number loop where a check is made to insure $M \geq 1.1$. Subroutine CODE is called to approximate the surface and diaphragm regions with a Mach box overlay. The subroutine POUT is called and the input flight conditions, geometry and map of the Mach box overlay are printed. The AIC station locations are also printed if the option is exercised. Following POUT, a check is made to determine if the number of boxes on the wing and control surface does not exceed 45.

The subroutine TRAMP is called by DRIVE to generate the substantial derivative matrix $[W]$. The $[W]$ matrix relates the Mach boxes on the surface to the AIC control points and serves as a substantial derivative operator. Subroutines called by TRAMP are CMAT, SMAT, TMAT, BMAT, RMAT and MINV.

A frequency loop is entered and velocity potential influence coefficients are calculated by subroutine CAFI. The coefficients are dependent on relative position of the Mach boxes, Mach number and reduced frequency.

The velocity potential is computed next. The source strength of the surface boxes is determined by satisfying the tangential flow boundary condition and source strength of the diaphragm boxes is computed through satisfaction of the boundary condition requiring the velocity potential **at the box centers be zero**. Diaphragm boxes in the wake of the leading surface have their source strength computed through satisfaction of the condition that the velocity potential be equal to the value computed by the wake condition. Boxes intersected by a leading or side edge have their source strengths adjusted by a linear interpolation formula based on the portion of the box area actually on the surface. This adjustment is performed by function subprogram ARLE. The velocity potential at the box centers on the surfaces is computed by subroutine PHIB by summing the box contributions.

The velocity potentials are converted to pressure through a substantial derivative operator generated by SD2. Multiplying pressure by the box area yields the force at each box center on the surfaces. These forces are transferred to the AIC stations through static considerations, thereby forming the AIC matrix. This operation is performed by subroutine FORCE. The output subroutine POUT is called to print the AIC matrix.

1.0 PROCESSING REQUIREMENTS

The input and output files used by the program are 05 and 06, respectively. All read and write statements are contained in the main program (DRIVE) and subroutines DAIN and POUT. Peripheral tape and disc units are not used by the program. Approximately 40,000 cells of core storage is required.

A standard input form of six 12-column fields per card is used by the program. Floating point numbers (6E12.5 format) may be anywhere within the appropriate field, but fixed point numbers (6I12 format) must be right adjusted. Detailed instructions for data input are given and listings of data cards for sample problems are provided.

2.0 INPUT INSTRUCTIONS

Instructions for preparing input data for the supersonic AIC computer program are presented here. The field location and format for each quantity is specified. Any set of units may be used for geometric dimensions and acoustic velocity as long as they are consistent, e.g., if inches is used for length, then the acoustic velocity must have dimensions of inches per second. The required data and the sequence in which the information is entered is as follows:

1. Streamwise Coordinates (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	X(1)	X(2)	X(3)	X(4)	X(5)	
Item	(1)	(2)	(3)	(4)	(5)	

(1) X(1) Wing root leading edge coordinate
(2) X(2) Wing tip leading edge coordinate
(3) X(3) Wing trailing edge coordinate
(4) X(4) Control surface leading edge coordinate
(5) X(5) Control surface trailing edge coordinate

A single surface, the wing, may be analyzed by setting X(4) and X(5) equal to X(3). The various configurations are generated as shown in Table 6.1. The origin for the planform and AIC station coordinates must be at the leading edge root of the wing, therefore X(1) and Y(1) described below, must always be zero.

2. Spanwise Coordinates and Acoustic Velocity (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	Y(1)	Y(2)	Y(3)	SOUND		
Item	(1)	(2)	(3)	(4)		

(1) Y(1) Wing root spanwise coordinate
(2) Y(2) Wing leading edge spanwise coordinate
(3) Y(3) Wing (and control surface) tip spanwise coordinate
(4) SOUND Speed of sound at altitude for which analysis is performed

TABLE 6.1 - OPTIONAL CONFIGURATIONS

CONFIGURATION	CHORDWISE COORDINATE	SPANWISE COORDINATE
RECTANGULAR	$X(1) = 0.0$ $X(2) = 0.0$ $X(3) > 0.0$ $X(4) \geq X(3)$ $X(5) \geq X(4)$	$Y(1) = 0.0$ $Y(2) = 0.0$ $Y(3) > 0.0$
DELTA	$X(1) = 0.0$ $X(2) > 0.0$ $X(3) = X(2)$ $X(4) \geq X(3)$ $X(5) \geq X(4)$	$Y(1) = 0.0$ $Y(2) = 0.0$ $Y(3) > 0.0$
TRAPEZOIDAL	$X(1) = 0.0$ $X(2) > 0.0$ $X(3) = X(2)$ $X(4) \geq X(3)$ $X(5) \geq X(4)$	$Y(1) = 0.0$ $Y(2) > 0.0$ $Y(3) > Y(2)$
TRAPEZOIDAL (CROPPED)	$X(1) = 0.0$ $X(2) > X(1)$ $X(3) > X(2)$ $X(4) \geq X(3)$ $X(5) \geq X(4)$	$Y(1) = 0.0$ $Y(2) > 0.0$ $Y(3) > Y(2)$
DELTA (CROPPED)	$X(1) = 0.0$ $X(2) > 0.0$ $X(3) > X(2)$ $X(4) \geq X(3)$ $X(5) \geq X(4)$	$Y(1) = 0.0$ $Y(2) = 0.0$ $Y(3) > Y(2)$

3. General Information (6I12 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	NMACH	KF	NFREQ	NBW	LPUNCH	
Item	(1)	(2)	(3)	(4)	(5)	

(1) NMACH Numberof Mach numbers (maximum 5)

(2) KF Option to input frequencies or reduced frequencies:

KF = 0 frequencies

KF = 1 reduced frequency

(3) NFREQ Number of frequencies or reduced frequencies at each Mach number (maximum 10)

(4) NBW Number of chordwise boxes on wing

(5) LPUNCH Option to punch AICs on cards:

LPUNCH = 0 no punch output

LPUNCH = 1 punch AICs for wing only

LPUNCH = 2 punch AICs for control surface only

LPUNCH = 3 punch individual AIC matrix for wing and control surface

LPUNCH = 4 punch total AIC matrix for wing-control surface combination

The AIC matrices are punched by rows with a IP6E12.5 format. Each row of an AIC matrix begins on a new card.

4. Mach Numbers (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	FMACH(1)	FMACH(2)	FMACH(3)	FMACH(4)	FMACH(5)	FMACH(6)
Item	(1)	(2)	(3)	(4)	(5)	(6)

(1) FMACH (1) Mach number

(2) FMACH (2) Mach number

. . .

. . .

. . .

(NMACH) FMACH (NMACH) Mach number

Enter NMACH value of Mach number (see Part 3, Item 1). Mach numbers must be greater than 1.1.

5. Frequencies (or Reduced Frequencies (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	FREQ(1)	FREQ(2)	FREQ(3)	FREQ(4)	FREQ(5)	FREQ(6)
Item	(1)	(2)	(3)	(4)	(5)	(6)

Input NFREQ values of frequency or reduced frequency (see Part 3, Items 2 and 3). Reduced frequency is defined as $k_r = \frac{\omega b_r}{U}$ where b_r is the semi-chord of the wing root, U is the free stream velocity and is the oscillatory angular frequency in radians/sec.

(1) FREQ (1)	frequency (cps) or k_r
(2) FREQ (2)	frequency (cps) or k_r
. .	.
. .	.
. .	.
(NFREQ) FREQ (NFREQ)	frequency (cps) or k_r

If NFREQ > 6, continue input of FREQ (7) to FREQ (NFREQ) on new card.

6. Number of AIC Stations (6I12 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	NXWING	NYWING	NXCS	NYCS		
Item	(1)	(2)	(3)	(4)		

(1) NXWING	Number of chordwise AIC collocation stations on wing
(2) NYWING	Number of spanwise AIC collocation stations on wing
(3) NXCS	Number of chordwise AIC collocation stations on control surface. Set equal to zero if analysis is for wing only
(4) NYCS	Number of spanwise AIC collocation stations on control surface. Set equal to zero if analysis is for wing only.

7. Spanwise Location of AIC Stations on Wing (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	YAIC(1,W)	YAIC(2,W)	YAIC(3,W)	YAIC(4,W)	YAIC(5,W)	YAIC(6,W)
Item	(1)	(2)	(3)	(4)	(5)	(6)

(1) YAIC (1,W) — Spanwise coordinate of first row of AIC collocation stations on wing

(2) YAIC (2,W) — Spanwise coordinate of second row of AIC collocation stations on wing

. . .

(NYWING) YAIC (NYWING, W) — Spanwise coordinate of last row of AIC collocation stations on wing

AIC station rows are numbered from root to tip of surface. If NYWING >6, continue input on new card(s).

8. Spanwise Location of AIC Stations on Control Surface (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	YAIC(1,CS)	YAIC(2,CS)	YAIC(3,CS)	YAIC(4,CS)	YAIC(5,CS)	YACI(6,CS)
Item	(1)	(2)	(3)	(4)	(5)	(6)

(1) YAIC (1,CS) — Spanwise coordinate for first row of AIC collocation stations on control surface

(2) YAIC (2,CS) — Spanwise coordinate of second row of AIC collocation stations on control surface

. . .

(NYCS) YAIC (NYCS, CS) — Spanwise coordinate of last row of AIC collocation stations on control surface

Omit this input if only the wing is analyzed. For NYCS > 6, continue input on new card(s). AIC station rows are numbered from root to tip of surface.

9. Chordwise Location of AIC Stations on Wing (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	XAIC(W,1,1)	XAIC(W,1,2)	XAIC(W1,3)	...	...	...
Item	(1)	(2)	(3)	(4)	(5)	(6)

(1) XAIC (W,1,1) Streamwise coordinate of first AIC collocation station in first row on wing

(2) XAIC (W,1,2) Streamwise coordinate of second AIC collocation station in first row on wing

. . .
. . .
. . .

(NXWING) XAIC(W, NYWING, NXWING) Streamwise coordinate of last AIC collocation station in last row on wing

Streamwise numbering sequence is from leading edge to trailing edge (see Figure 6.3). Continue input of values for each row immediately after the last value of the preceeding row; do not begin input of each row on new card.

10. Chordwise Location of AIC Stations on Control Surface (6E12.5 format)

Column	1-12	13-24	25-36	37-48	49-60	61-72
Name	XAIC(CS,1,1)	XAIC(CS,1,2)	XAIC(CS,1,3)	...	...	...
Item	(1)	(2)	(3)	(4)	(5)	(6)

Procedure to input streamwise coordinate location of AIC stations on control surface is the same as wing above. Omit this input if only wing is analyzed.

3.0 SAMPLE PROBLEMS

Three sample problems are presented to demonstrate the use of the supersonic AIC computer program. Configurations analyzed include a trapezoidal wing-rectangular control surface combination, a cropped trapezoidal wing and a delta wing. Description of input parameters and complete listing of input data cards and computer output are given with each sample problem.

Sample Problem 1.

Supersonic AICs are computed for a trapezoidal wing and rectangular control surface. The planform geometry and AIC stations are shown in Figure 6.5. The dimensional unit used for length is feet, therefore the acoustic velocity is entered as ft/sec. The analysis is for M = 1.5, k_r = 0.10 and a =1116.87 ft/sec (sea level). Four chordwise boxes are used for the wing. The resulting box overlay has 15 boxes on the wing and 8 on the control surface, thereby satisfying the 45 box limitation. Also, there are 13 diaphragm boxes in the gap and outboard region. Input parameters are summarized below and a listing of the input data cards and computer output follows.

X(1) = 0.0' X(2) = 1.0' X(3) = 2.0' X(4) = 3.0' X(5) = 4.0'

Y(1) = 0.0' Y(2) = 1.0' Y(3) = 2.0'

SOUND = 1116.87 ft/sec	Acoustic velocity (sea level)
NMACH = 1	Number of Mach numbers
KF = 1	Input reduced frequency
NFREQ = 1	Number of reduced frequencies
NBW = 4	Numberof chordwise boxes on wing
LPUNCH = 4	Punch combined wing-control surface AIC matrix on cards
FMACH (1) = 1.5	Mach number
FREQ (1) = 0.10	Reduced frequency
NXWING = 4	Number of chordwise AIC stations on wing
NYWING = 4	Number of spanwise AIC stations on wing
NXCS = 2	Number of chordwise AIC stations on control surface
NYCS = 3	Number of spanwise AIC stations on control surface

YAIC(1,W) = 0.2'	YAIC(2,W) = 0.7'	YAIC(3,W) = 1.3'
YAIC(4,W) = 1.8'		
YAIC(1,CS) = .3'	YAIC(2,CS) = 1.0'	YAIC(3,CS) = 1.7'
XAIC(1,1,W) = 0.10'	XAIC(1,2,W) = 0.70'	XAIC(1,3,W) = 1.30'
XAIC(1,4,W) = 1.90'		
XAIC(2,1,W) = 0.10'	XAIC(2,2,W) = 0.70'	XAIC(2,3,W) = 1.30'
XAIC(2,4,W) = 1.90'		
XAIC(3,1,W) = 0.38'	XAIC(3,2,W) = 0.90'	XAIC(3,3,W) = 1.405'
XAIC(3,4,W) = 1.915'		
XAIC(4,1,W) = 0.86'	XAIC(4,2,W) = 1.22'	XAIC(4,3,W) = 1.58'
XAIC(4,4,W) = 1.94'		
XAIC(1,1,CS) = 3.25'	XAIC(1,2,CS) = 3.75'	
XAIC(2,1,CS) = 3.25'	XAIC(2,2,CS) = 3.75'	
XAIC(3,1,CS) = 3.25'	XAIC(3,2,CS) = 3.75'	

YAIC(1,W) = 0.2'	YAIC(2,W) = 0.7'	YAIC(3,W) = 1.3'
YAIC(4,W) = 1.8'		
YAIC(1,CS) = .3'	YAIC(2,CS) = 1.0'	YAIC(3,CS) = 1.7'
XAIC(1,1,W) = 0.10'	XAIC(1,2,W) = 0.70'	XAIC(1,3,W) = 1.30'
XAIC(1,4,W) = 1.90'		
XAIC(2,1,W) = 0.10'	XAIC(2,2,W) = 0.70'	XAIC(2,3,W) = 1.30'
XAIC(2,4,W) = 1.90'		
XAIC(3,1,W) = 0.38'	XAIC(3,2,W) = 0.90'	XAIC(3,3,W) = 1.405'
XAIC(3,4,W) = 1.915'		
XAIC(4,1,W) = 0.86'	XAIC(4,2,W) = 1.22'	XAIC(4,3,W) = 1.58'
XAIC(4,4,W) = 1.94'		
XAIC(1,1,CS) = 3.25'	XAIC(1,2,CS) = 3.75'	
XAIC(2,1,CS) = 3.25'	XAIC(2,2,CS) = 3.75'	
XAIC(3,1,CS) = 3.25'	XAIC(3,2,CS) = 3.75'	

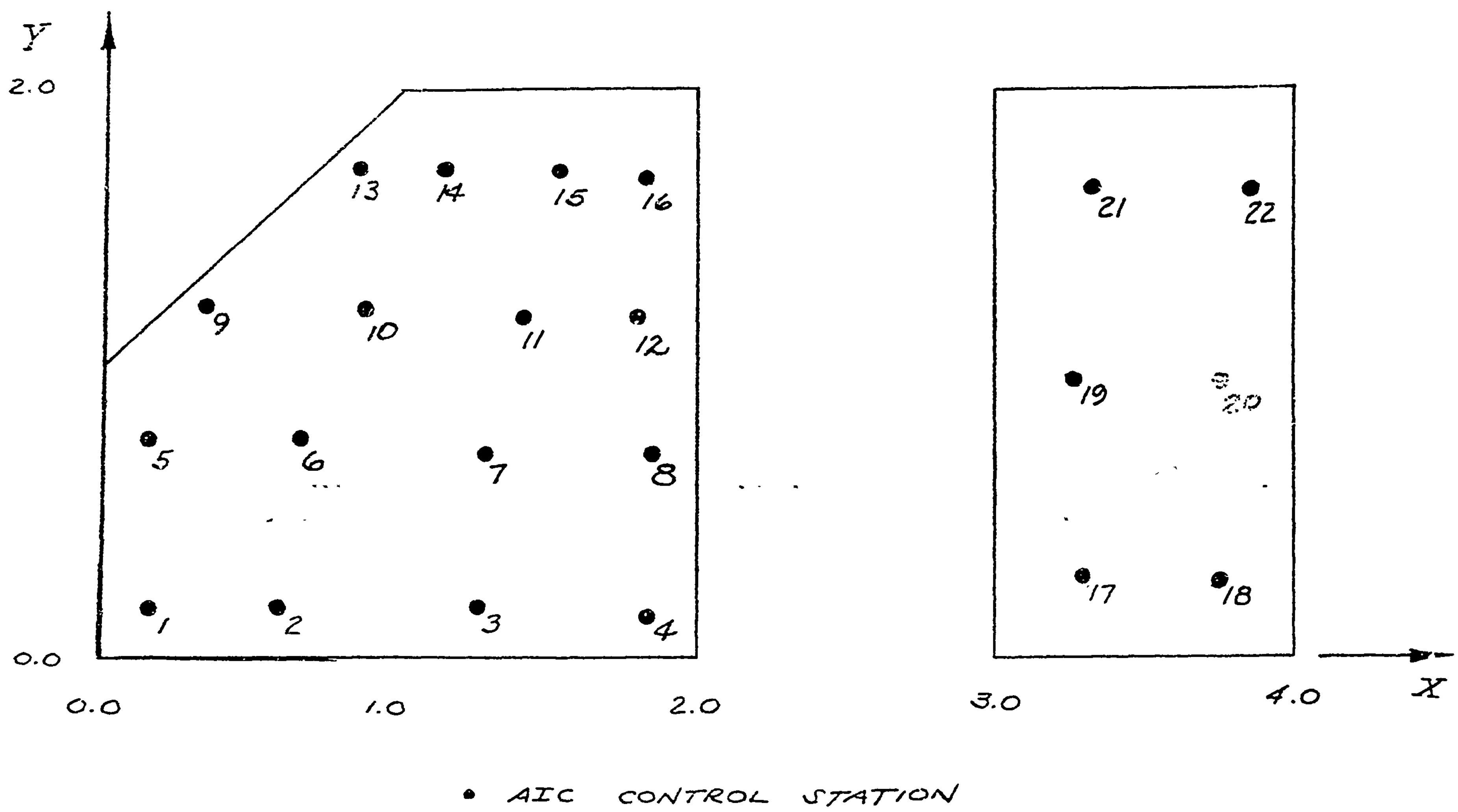


FIGURE 6.5 - SUPERSONIC SAMPLE PROBLEM 1.

```
                                DATA CARD COLUMN NUMBER
********************************************************************************
         11111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
********************************************************************************

0.0       1.0       2.0       3.0       4.0
0.0       1.0       2.0       1116.87
         1         1         1         4         4
1.5
0.1
         4         4         2         3
0.20      0.70      1.30      1.80                                    Y-WING
0.30      1.00      1.70                                              Y-TAIL
0.100     0.700     1.300     1.900     0.100     0.700               X-WING
1.300     1.900     0.380     0.900     1.405     1.915               X-WING
9.860     1.220     1.580     1.940                                   X-WING
3.250     3.750     3.250     3.750     3.250     3.750               X-TAIL

********************************************************************************
         11111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
********************************************************************************
                                DATA CARD COLUMN NUMBER
```

FIGURE 6.6 — LISTING OF INPUT DATA CARDS FOR SUPERSONIC PROBLEM 1.

HUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM

FLIGHT CONDITIONS AND GEOMETRY

MACH NUMBER = 1.50000   SPEED OF SOUND = 1116.870 L/T   RHO= 1.00

	WING	TAIL
L.E. STATION (L)	0.	3.000
ROOT CHORD (L)	2.000	1.000
L.E. SPAN (L)	1.000	2.000
T.E. SPAN (L)	2.000	2.000
TIP CHORD (L)	1.000	1.000
TOTAL AREA (L*L)	7.000	4.000
CHORDWISE BOXES	4	2
SPANWISE BOXES	4	4

TOTAL CHORDWISE BOXES = 7   BOX CHORD = 5.71429E-01 L   BOX SPAN = 5.11101E-01 L

HUGHES AIRCRAFT CO, SUPERSONIC AIC PROGRAM (CONT-D)

```
MAP OF MACH BOX OVERLAY ON     SSS
WING, TAIL, AND DIAPHRAGM      SSSS
         (S) - WING            SSSS.
         ($) - TAIL            SSSS..
         (,) - WAKE            ,,,,,,,
         (.) - DIAPHRAGM       $$$$..
                               $$$$.
```

AIC COLLOCATION STATION COORDINATES ON THE WING

YAIC	XAIC VALUES--			
0.200000E 00	0.100000E 00	0.700000E 00	0.130000E 01	0.190000E 01
0.700000E 00	0.100000E 00	0.700000E 00	0.130000E 01	0.190000E 01
0.130000E 01	0.380000E 00	0.900000E 00	0.140500E 01	0.191500E 01
0.180000E 01	0.850000E 00	0.122000E 01	0.158000E 01	0.194000E 01

HUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM (CONT-D)

AIC COLLOCATION STATION COORDINATES ON THE TAIL

YAIC	XAIC VALUES--	
0.390000E 00	0.325000E 01	0.375000F 01
0.100000E 01	0.325000E 01	0.375000E 01
0.170000E 01	0.325000E 01	0.375000F 01

HUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM (CONT-D)

OSCILLATORY FREQUENCY (CPS) 2.66633E 01

REFERENCE CHORD 1.00000E 00

REDUCED FREQUENCY (REF. CHORD) 1.00000E-01

REDUCED VELOCITY (REF. CHORD) 1.00000E 01

FREE STREAM MACH NUMBER 1.50000E 00

FREE STREAM VELOCITY 1.67530E 03

DENSITY 1.00

DYNAMIC PRESSURE (1/2*RHO*VEL**2) 1.40332E 06

AERODYNAMIC INFLUENCE COEFFICIENTS

RL	IM	RL	IM	RL	IM	RL	IM	RL	IM
ROW = 1									
1.8526E 01	-2.1350E 00	-7.4711E 00	1.1745E 00	-1.7022E 01	-5.3347E-01	5.9082E 00	6.5727E-02	8.5079E 00	-5.3460E-01
-1.7824E 01	8.0830E-01	1.1737E 01	-4.5722E-01	-2.4169E 00	8.6140E-02	1.7266E 00	7.9486E-02	-6.8265E-01	-2.1813E-01
-1.6490E 00	7.9415E-03	6.1367E-01	5.2591E-03	-1.3995E-01	-3.4482E-02	3.4869E-04	4.6109E-02	2.2277E-01	2.2419E-03
-8.5426E-02	-1.1001E-03	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.						
ROW = 2									
4.2209E 00	-3.7703E-01	1.7189E 01	-7.4886E-01	-2.1317E 01	-4.7041E-01	-1.2466E-01	4.8262E-02	1.1807E 01	-1.5450E 00
-1.5303E 01	9.1834E-01	3.0776E 00	1.8774E-01	3.4872E-01	-4.2794E-02	3.2466E 00	-5.2381E-01	-1.1039E 00	3.3208E-01
-2.1352E 00	-1.4747E-01	-2.9927E-02	1.2573E-02	-5.1404E-01	8.7424E-02	2.0671E-01	-5.5795E-02	3.0762E-01	1.8560E-02
3.4794E-03	-1.5341E-03	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.						
ROW = 3									
-1.2637E 01	1.4622E 00	1.7835E 00	-9.8145E-01	1.6454E 01	-1.0673E 00	-2.1619E 01	-2.5826E-01	5.1414E 00	-1.0442E 00
3.8143E 00	-4.8789E-01	-1.1642E 01	6.4721E-01	2.5698E 00	1.8758E-01	3.4387E 00	-9.5692E-01	-8.6434E-01	3.6573E-01
9.8238E-02	1.1292E-01	-2.7424E 00	-3.0093E-02	5.9097E-02	8.5600E-03	-3.6956E-01	3.1835E-02	-7.7395E-02	2.4689E-03
3.9197E-01	2.2605E-03	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.						
ROW = 4									
-2.6279E 00	1.0374E 00	-2.4266E 01	7.1643E-03	6.2085E 01	-3.6780E-01	-3.5132E 01	-1.0056E 00	-5.1481E 00	7.2075E-01
1.6028E 01	-1.9470E 00	-1.0770E 01	3.7016E-01	-1.7884E-01	4.9600E-01	1.7865E 00	-5.0265E-01	-8.9012E-02	-5.4621E-01
2.9135E 00	7.6823E-01	-4.6846E 00	-1.6069E-01	1.3096E 00	-2.3905E-01	-1.4007E 00	2.6910E-01	-5.8988E-01	-6.0818E-02
6.7650E-01	1.7474E-02	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.						
ROW = 5									
1.7100E 01	-1.4548E 00	-2.4655E 01	1.4477E 00	8.4535E 00	-7.5430E-01	-9.1659E-01	1.2872E-01	3.5176E 00	-3.8592E-01
1.1802E 01	-4.9408E-01	-2.1320E 01	1.5970E-01	5.9850E 00	-4.1859E-02	7.7272E 00	-9.2137E-01	-9.0645E 00	9.5001E-01
8.8348E-01	-5.0032E-01	4.5573E-01	8.4067E-02	-2.4249E 00	2.6727E-01	2.6694E 00	-2.0636E-01	-1.0295E-01	4.9678E-02
-1.3434E-01	-2.4436E-03	0.	0.	0.	0.	0.	0.	0.	0.
0.	0.	0.	0.						

```
ROW = 6
  1.5732E 01 -1.9826E 00 -1.2550E 01  8.0769E-01 -3.6703E 00  9.3060E-02  3.9372E-01 -3.8218E-02 -4.2715E 00  5.1245E-01
  2.0987E 01 -7.6767E-01 -1.6261E 01 -5.9617E-01 -4.3771E-01  8.1209E-02 -6.6609E 00 -6.4227E-01 -1.7456E 00 -3.3327E-02
 -5.1798E 00  4.2693E-02  2.3174E-01 -2.2418E-02 -9.6993E-02  3.9113E-03 -6.1797E-01  5.0061E-02  7.0449E-01  6.4920E-03
  1.2207E-02 -2.6306E-03  0.          0.          0.          0.          0.          0.          0.          0.
  0.          0.          0.          0.

ROW = 7
  1.3620E 00 -6.1060E-01  1.1198E 01 -1.0407E 00 -8.4425E 00  4.2144E-01 -4.2394E 00  1.3789E-01 -6.3402E 00  1.5685E-01
  3.4923E 00  8.1771E-01  1.9651E 01 -1.1136E 00 -1.6786E 01 -3.3654E-01  2.0881E 00 -4.4518E-01  4.9280E 00 -3.5978E-01
 -1.3823E 00 -3.7827E-02 -5.6935E 00  7.4561E-02  2.3126E 00 -2.7173E-01 -2.0918E 00  9.2178E-02 -7.6411E-01  8.9198E-02
  5.3144E-01  1.7651E-02  0.          0.          0.          0.          0.          0.          0.          0.
  0.          0.          0.          0.

ROW = 8
 -7.3730E 00  1.3901E 00  1.0845E 01 -2.3873E 00  8.6800E 00  2.4134E-01 -1.2200E 01  2.6576E-01  5.2127E 00 -1.1891E 00
 -2.7980E 01  1.7542E 00  4.6272E 01  2.1651E-01 -2.3530E 01 -1.1663E 00  1.2151E 00 -8.3385E-01 -2.4266E 00  5.7816E-01
  1.3330E 01 -4.5693E-01 -1.2192E 01  1.0603E-01  5.0321E-01 -2.3364E-01  2.4774E 00 -5.0119E-02 -3.8577E 00  1.2494E-01
  8.5890E-01  5.1899E-02  0.          0.          0.          0.          0.          0.          0.          0.
  0.          0.          0.          0.

ROW = 9
 -2.8884E 00  1.1679E 00  1.6734E 00 -1.3424E 00  1.8203E 00  2.0160E-01 -5.5214E-01 -1.0224E-02  2.0606E 01 -3.0743E 00
 -2.0241E 01  2.6356E 00 -2.2724E 00 -7.9483E-01  1.8068E 00  8.4478E-02 -7.1084E 00  1.0122E 00  2.2934E 01 -1.5651E 00
 -2.0626E 01  3.3247E-01  4.8277E 00 -4.5569E-02 -1.5794E 00  1.1640E-01  8.1475E-01  6.8349E-02  1.1543E 00 -1.1374E-01
 -3.8423E-01  2.9035E-02  0.          0           0.          0.          0.          0.          0.          0.
  0.          0.          0.          0.

ROW =10
  5.1967E 00 -4.3124E-01 -7.4376E 00  5.3458E-01  2.2566E 00 -3.2124E-01 -1.4332E-02  4.6689E-02  8.8063E 00 -2.2514E 00
 -3.3797E 00  1.3629E 00 -5.3979E 00  1.3482E-01 -1.4762E-01 -1.7592E-01 -4.3915E 00 -2.8525E-01  4.6287E 01 -1.2780E 00
 -5.1685E 01  3.4108E-01  9.7497E 00 -1.2216E-01  9.1662E-01 -4.7758E-01  8.6125E 00  3.9927E-01 -1.2822E 01 -3.0039E-01
  3.2801E 00  7.6775E-02  0.          0.          0.          0.          0.          0.          0.          0.
  0.          0.          0.          0.

ROW =11
  1.2129E 01 -3.2864E 00 -9.2228E 00  1.9974E 00 -3.6600E 00  4.0965E-01  5.5196E-01  2.3562E-03 -8.8456E 00  1.6449E 00
  1.5040E 01 -1.7656E 00 -3.1946E-01 -3.2553E-03 -5.8505E 00  9.0000E-02 -6.9172E 00  8.9534E-01  8.5671E 00 -4.9192E-01
  2.6525E 01 -1.4469E 00 -2.8168E 01 -4.9391E-02 -8.9305E-01  1.7874E-01  1.8338E 00 -1.5793E-01  5.2769E 00 -2.8839E-01
 -6.2179E 00  5.1444E-03  0.          0.          0.          0.          0.          0.          0.          0.
  0.          0.          0.          0.

ROW =12
  3.8515E 00 -1.9871E 00  3.9377E 00  3.1948E-01 -8.5665E 00  1.0438E 00  5.9798E-01 -4.9331E-02 -2.7188E 00  1.0966E 00
 -3.6064E 00 -6.0563E-01  1.5506E 01 -6.2899E-01 -9.1396E 00  1.2535E-01 -1.0320E 01  1.6344E 00 -9.5887E 00 -1.6528E 00
  5.6993E 01  8.4397E-01 -3.7053E 01 -1.1533E 00 -3.8383E 00  4.9343E-01  4.7071E-01 -6.0431E-01  1.2288E 01  3.3094E-01
 -8.9137E 00 -2.8992E-01  0.          0.          0.          0.          0.          0.          0.          0.
  0.          0.          0.          0.

ROW =13
 -2.0477E 00  1.0999E 00  1.4642E 00 -8.8472E-01  8.4089E-01 -8.7020E-02 -1.9299E-01  2.9998E-02  1.3582E 01 -3.3904E 00
 -1.7144E 01  3.1157E 00  3.0505E 00 -2.4573E-01  3.6905E-01 -1.1726E-01 -6.3042E 00  1.5540E-01  4.2422E 01 -1.6605E 00
 -4.7120E 01  7.8628E-01  1.0976E 01 -1.6909E-01 -1.1119E 00 -2.4934E-01  1.3827E 01  2.9381E-01 -1.2513E 01 -3.9082E-01
  2.7936E 00  9.7641E-02  0.          0.          0.          0.          0.          0.          0.          0.
  0.          0.          0.          0.

ROW =14
  2.4209E 00 -6.1107E-01 -2.6100E 00  7.5158E-01  4.8265E-01 -8.6530E-02 -1.2613E-01 -6.5638E-04 -4.3732E-01  4.5807E-01
  2.9000E 00 -8.1067E-01 -3.3561E 00  3.4276E-01  6.8893E-01  3.1633E-02 -3.2191E 00  3.7046E-01  4.1591E 00 -1.5081E-01
  6.5063E 00 -5.5707E-01 -7.4396E 00  4.3529E-02 -9.1653E-01  1.0140E-01  6.0226E-01  6.5012E-03  3.0400E 00 -1.4417E-01
 -2.7207E 00 -2.6411E-02  0.          0.          0.          0.          0.          0.          0.          0.
```

```
 0.          0.          0.          0.

ROW =15
 3.3344E 00 -1.1180E 00 -3.8787E 00  1.0491E 00  6.6395E-01 -1.1092E-01 -1.7372E-01 -1.1795E-03 -6.0235E-01  4.9319E-01
 3.9943E 00 -1.1169E 00 -4.6225E 00  4.7211E-01  1.2244E 00  4.3570E-02 -4.4338E 00  5.1025E-01  5.7286E 00 -2.0772E-01
 8.9615E 00 -6.9842E-01 -1.0247E 01  5.9955E-02 -1.2624E 00  1.3967E-01  8.2953E-01  8.9544E-03  4.1872E 00 -1.9857E-01
-3.7474E 00 -3.6377E-02  0.          0.          0.          0.          0.          0.          0.          0.
 0.          0.          0.          0.

ROW =16
 6.8687E 00 -2.2574E 00 -7.5080E 00  2.0209E 00  7.3016E-01 -1.3947E-01 -2.0284E-01 -2.0056E-02 -7.9416E 00  2.1261E 00
 1.5602E 01 -2.7972E 00 -9.5382E 00  6.2306E-01  1.9253E 00  1.8359E-01 -4.5300E 00  7.0389E-01 -1.1318E 01 -4.5894E-01
 3.9059E 01  1.8899E-01 -2.3188E 01 -6.3079E-01 -1.6397E 00  3.3489E-01 -3.9637E 00 -3.9954E-01  1.3478E 01  4.1626E-01
-7.8634E 00 -3.7612E-01  0.          0.          0.          0.          0.          0.          0.          0.
 0.          0.          0.          0.

ROW =17
-1.5422E 00  1.0713E-01 -6.5999E 00  2.9380E 00 -8.4414E 00  2.7786E 00  1.7035E 01 -4.2164E 00 -6.1041E 00  3.3490E 00
 4.8059E 00 -3.0375E 00  3.2738E 00 -4.2658E-01 -1.8346E 00  4.3112E-01 -2.9057E 00  2.3434E 00  5.3412E 00 -2.4224E 00
 5.7878E 00 -1.9423E 00 -8.3296E 00  2.7424E 00  6.5802E-01 -3.5967E-01  4.9442E-01 -1.7731E-01  2.2773E 00 -7.4962E-01
-3.5177E 00  1.0432E 00  4.6865E 01 -3.4723E 00 -4.7011E 01  1.1239E 00  4.2022E 00 -9.8699E-01 -4.2341E 00  7.7524E-01
 3.0549E 00 -2.6676E-01 -3.0055E 00  1.1361E-01

ROW =18
-1.6991E 00  5.6199E-03 -7.5912E 00  2.9233E 00 -9.7727E 00  2.6586E 00  1.9475E 01 -3.7569E 00 -7.0604E 00  3.4083E 00
 5.6023E 00 -3.1426E 00  3.7182E 00 -2.8986E-01 -2.1211E 00  3.8434E-01 -3.3265E 00  1.3315E 00  6.1768E 00 -2.4203E 00
 6.6508E 00 -1.8545E 00 -9.6065E 00  2.6163E 00  7.6627E-01 -3.6785E-01  5.6910E-01 -1.7173E-01  2.6189E 00 -7.1333E-01
-4.0395E 00  9.7253E-01  5.3292E 01 -1.1696E 00 -5.3310E 01 -1.4991E 00  4.8007E 00 -8.6748E-01 -4.8242E 00  6.2662E-01
 3.4752E 00 -1.2186E-01 -3.4782E 00 -5.2194E-02

ROW =19
-9.0028E 00  4.8528E 00  9.5466E 00 -5.2473E 00  7.3209E 00 -1.6063E 00 -7.7885E 00  2.0627E 00  1.6335E 00 -1.2641E 00
-5.6728E 00  2.7683E 00 -4.9215E 00  1.0459E 00  9.1152E 00 -1.8242E 00 -4.7170E 00  1.7896E 00  1.4042E-01 -5.6197E-01
-9.0141E 00  3.6535E 00  1.3914E 01 -3.7397E 00 -1.5076E 00  5.3918E-01  1.7788E 00 -6.3653E-01 -4.3581E 00  1.4800E 00
 4.1530E 00 -1.1619E 00  1.3312E 01 -1.7487E 00 -1.3375E 01  1.0783E 00  3.4386E 01 -1.9176E 00 -3.4475E 01  2.0062E-01
 1.0464E 01 -1.2678E 00 -1.0516E 01  6.8348E-01

ROW =20
-1.0407E 01  4.9290E 00  1.1065E 01 -5.3538E 00  8.3844E 00 -1.3884E 00 -8.9588E 00  1.8807E 00  1.9370E 00 -1.3403E 00
-6.5353E 00  2.7825E 00 -5.6718E 00  9.0549E-01  1.0400E 01 -1.5232E 00 -5.3978E 00  1.7276E 00  2.2553E-01 -6.3065E-01
-1.0466E 01  3.6091E 00  1.5934E 01 -3.4034E 00 -1.7298E 00  5.1860E-01  2.0503E 00 -6.1407E-01 -5.0199E 00  1.4162E 00
 4.7610E 00 -1.0679E 00  1.5163E 01 -1.1904E 00 -1.5194E 01  4.3062E-01  3.9081E 01 -4.4701E-01 -3.9080E 01 -1.8040E 00
 1.1916E 01 -8.1706E-01 -1.1940E 01  1.5288E-01

ROW =21
-1.6821E 00  6.0971E-01  2.6588E 00 -1.0174E 00  8.8155E 00 -3.2125E 00 -9.9908E 00  3.0593E 00 -2.2617E 00  1.2332E 00
 6.7225E 00 -3.2604E 00 -7.3815E 00  2.9098E 00  2.9332E 00 -7.9501E-01  6.3373E-01 -3.5127E-01 -1.7124E 01  4.5600E 00
 1.2523E 01 -1.5058E 00  4.2186E 00 -1.7421E 00  3.7339E-01 -6.0325E-02 -8.0304E 00  2.2284E 00  9.5157E 00 -2.0469E 00
-1.7819E 00  1.1250E-01 -2.0551E 00  8.3307E-03  2.0575E 00  9.4394E-02  2.4196E 01 -2.2776E 00 -2.4282E 01  1.0941E 00
 1.3650E 01  3.5132E-02 -1.3698E 01 -1.0762E 00

ROW =22
-1.9159E 00  5.8143E-01  3.0554E 00 -9.9052E-01  1.0151E 01 -3.1116E 00 -1.1463E 01  2.8793E 00 -2.6115E 00  1.2512E 00
 7.7790E 00 -3.2835E 00 -8.4945E 00  2.8495E 00  3.3348E 00 -7.2074E-01  7.5595E 01 -3.6952E-01 -1.9557E 01  4.1338E 00
 1.4118E 01 -9.4038E-01  4.9064E 00 -1.7269E 00  4.2741E-01 -4.7139E-02 -9.1825E 00  2.0406E 00  1.0825E 01 -1.7431E 00
-1.9964E 00  1.8055E-02 -2.3322E 00 -1.1117E-01  2.3288E 00  2.2786E-01  2.7530E 01 -1.1511E 00 -2.7557E 01 -1.9396E-01
 1.5492E 01  8.4025E-01 -1.5484E 01 -2.0232E 00
```

Sample Problem 2.

A cropped trapezoidal wing is analyzed at M = 2.0, k_r = 0.10 and a = 1116.87 ft/sec (sea level). The trailing surface is removed from the analysis by setting X(5) = X(4) = X(3). The wing geometry and AIC stations are shown in Figure 6.7. Five chordwise boxes were specified. The resulting overlay has 32 boxes on the wing and 2 diaphragm boxes. Input information is summarized below and a listing of the input data cards and computer output follows.

X(1) = 0.0' X(2) = 1.0' X(3) = 2.0' X(4) = 2.0' X(5) = 2.0'
Y(1) = 0.0' Y(2) = 1.0' Y(3) = 2.0'

SOUND = 1116.85 ft/sec	Acoustic velocity (sea level)
NMACH = 1	Number of Mach numbers
KF = 1	Input reduced frequency
NFREQ = 1	Number of reduced frequencies
NBW = 5	Number of chordwise boxes on wing
LPUNCH = 0	Do not punch AIC matrix on cards
FMACH (1) = 2.0	Mach number
FREQ (1) = 0.10	Reduced frequency
NXWING = 3	Number of chordwise AIC stations on wing
NYWING = 5	Number of spanwise AIC stations on wing
NXCS = 0	Number of chordwise AIC stations on control surface
NYCS = 0	Number of spanwise AIC stations on control surface

YAIC(1,W) = 0.20' YAIC(2,W) = 0.60' YAIC(3,W) = 1.00'
YAIC(4,W) = 1.40' YAIC(5,W) = 1.80'

XAIC(1,1,W) = 0.575' XAIC(1,2,W) = 1.050' XAIC(1,3,W) = 1.525'
XAIC(2,1,W) = 0.725' XAIC(2,2,W) = 1.150' XAIC(2,3,W) = 1.575'
XAIC(3,1,W) = 0.875' XAIC(3,2,W) = 1.250' XAIC(3,3,W) = 1.625'
XAIC(4,1,W) = 1.025' XAIC(4.2,W) = 1.350' XAIC(4,3,W) = 1.675'
XAIC(5,1,W) = 1.175' XAIC(5,2,W) = 1.450' XAIC(5,3,W) = 1.725'

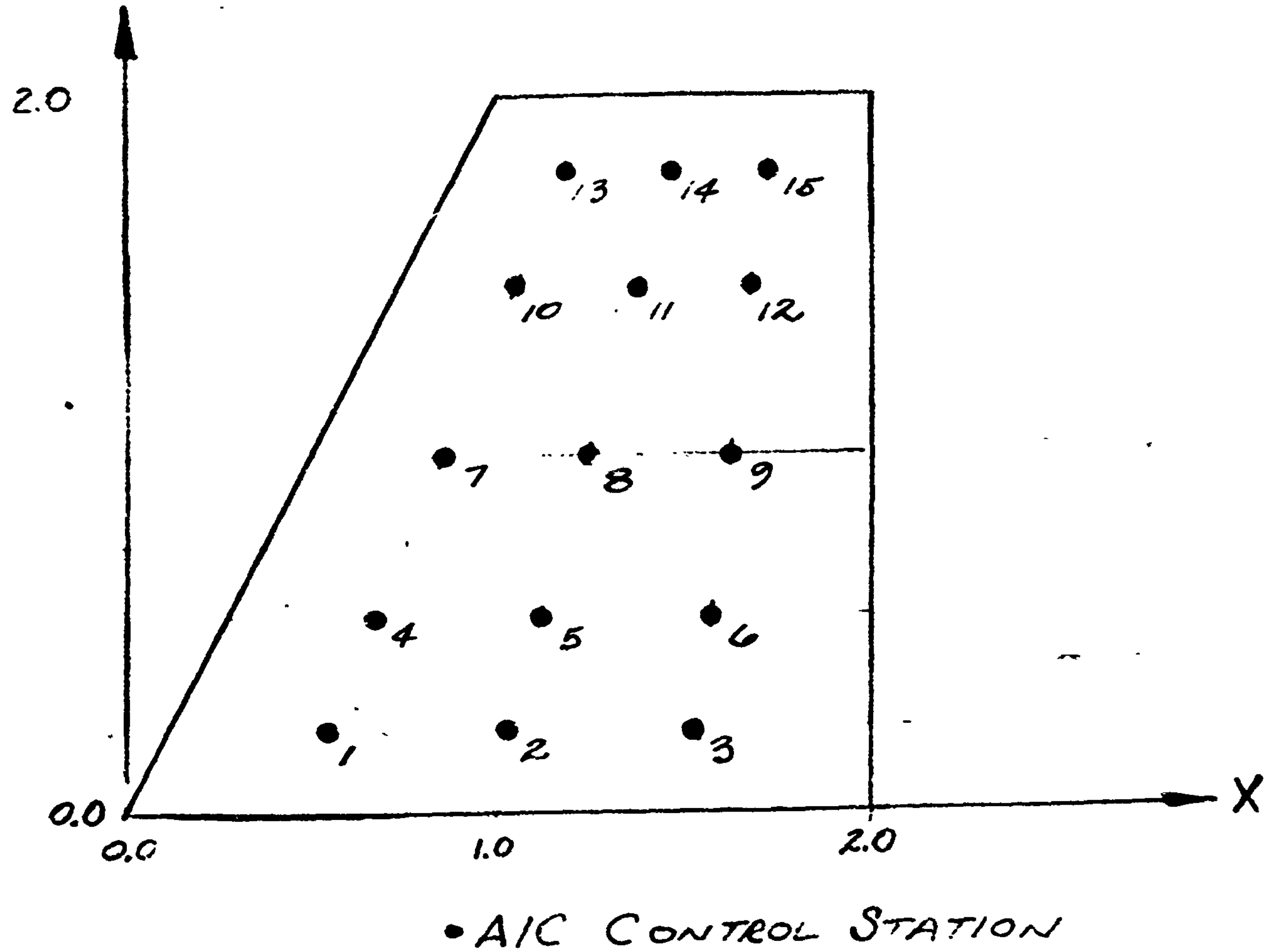


FIGURE 6.7 SUPERSONIC SAMPLE PROBLEM 2

```
                         DATA CARD COLUMN NUMBER
********************************************************************************
         11111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
********************************************************************************


0.0       1.0       2.0       2.0       2.0
0.0       0.0       2.0       1116.87
         1         1         1         5         0
2.0                                                                  MACH NO.
0.1                                                                  RED FREQ
         3         5         0         0
0.200     0.600     1.000     1.400     1.800                        Y-WING
0.575     1.050     1.525     0.725     1.150     1.575              X-WING
0.875     1.250     1.625     1.025     1.350     1.675              X-WING
1.175     1.450     1.725                                            X-WING


********************************************************************************
         11111111112222222222333333333344444444445555555555666666666677777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
********************************************************************************
                         DATA CARD COLUMN NUMBER
```

FIGURE 6.8 - LISTING OF DATA CARDS FOR SUPERSONIC SAMPLE PROBLEM 2.

HUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM

FLIGHT CONDITIONS AND GEOMETRY

MACH NUMBER = 2.00000   SPEED OF SOUND = 1116.870 L/T   RHO= 1.00

	WING	TAIL
L.E. STATION (L)	0.	2.000
ROOT CHORD (L)	2.000	0.
L.E. SPAN (L)	0.	2.000
T.E. SPAN (L)	2.000	2.000
TIP CHORD (L)	1.000	0.
TOTAL AREA (L*L)	6.000	0.
CHORDWISE BOXES	5	0
SPANWISE BOXES	8	8

TOTAL CHORDWISE BOXES = 5   BOX CHORD = 4.44444E-01 L   BOX SPAN = 2.56600E-01 L

```
MAP OF MACH BOX OVERLAY ON     SS
WING, TAIL, AND DIAPHRAGM      SSSSSS
         (S) - WING            SSSSSSSS.
         ($) - TAIL            SSSSSSSS.
         (,) - WAKE            SSSSSSSS
```

HUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM (CONT-D)

AIC COLLOCATION STATION COORDINATES ON THE WING

YAIC	XAIC VALUES--		
0.200000E 00	0.575000E 00	0.105000E 01	0.152500E 01
0.600000E 00	0.725000E 00	0.115000E 01	0.157500E 01
0.100000E 01	0.875000E 00	0.125000E 01	0.162500E 01
0.140000E 01	0.102500E 01	0.135000E 01	0.167500E 01
0.180000E 01	0.117500E 01	0.145000E 01	0.172500E 01

HUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM (CONT-D)

OSCILLATORY FREQUENCY (CPS) 3.55511E 01

REFERENCE CHORD 1.00000E 00

REDUCED FREQUENCY (REF. CHORD) 1.00000E-01

REDUCED VELOCITY (REF. CHORD) 1.00000E 01

FREE STREAM MACH NUMBER 2.00000E 00

FREE STREAM VELOCITY 2.23374E 03

DENSITY 1.00

DYNAMIC PRESSURE (1/2*RHO*VEL**2) 2.49480E 06

AERODYNAMIC INFLUENCE COEFFICIENTS

RL	IM	RL	IM	RL	IM	RL	IM	RL	IM
ROW = 1									
8.2860E 01	-4.5122E 00	-1.2642E 02	4.0978E 00	4.3569E 01	-1.5152E 00	-3.9196E 01	3.1016E 00	5.9121E 01	-3.2721E 00
-1.9901E 01	1.1306E 00	1.5757E 01	-1.2014E 00	-2.3936E 01	1.2691E 00	8.1718E 00	-4.4785E-01	-2.4720E 00	1.8129E-01
3.7527E 00	-1.8728E-01	-1.2797E 00	6.6115E-02	2.4598E-01	-1.4841E-02	-3.7253E-01	1.3461E-02	1.2651E-01	-4.8110E-03
ROW = 2									
2.6648E 01	-1.0626E 00	-3.1793E 01	6.4230E-01	5.1599E 00	-6.2222E-01	1.0975E 00	4.7470E-01	-5.8896E 00	-3.8164E-01
4.8119E 00	1.0755E-01	-9.5343E-01	2.0185E-01	3.0098E 00	-3.6046E-01	-2.0535E 00	9.0601E-02	1.1671E-02	-2.2441E-03
-2.6594E-01	1.5682E-02	2.5425E-01	-5.4586E-05	8.1137E-02	-1.7226E-02	-9.6811E-02	2.2557E-02	1.5422E-02	-8.2748E-03
ROW = 3									
-1.0319E 01	8.2589E-01	4.2487E 01	-4.2077E-01	-3.2107E 01	-1.4610E 00	3.9416E 01	-3.2900E 00	-6.8665E 01	4.7232E 00
2.9249E 01	-1.8321E 00	-1.6221E 01	4.2059E 00	2.6893E 01	-5.6525E 00	-1.0593E 01	1.6383E 00	4.3162E 00	-1.0737E 00
-6.9687E 00	1.4718E 00	2.6342E 00	-4.5779E-01	-1.3972E 00	3.3746E-01	2.1875E 00	-4.7069E-01	-7.8496E-01	1.5583E-01
ROW = 4									
7.8487E 00	-9.0918E-01	-1.5460E 01	1.6968E 00	7.6242E 00	-7.8776E-01	2.6546E 01	-1.1990E 00	-3.0703E 01	1.1395E-01
4.1258E 00	1.0679E-01	1.3691E 01	-7.7754E-01	-2.2820E 01	1.0676E 00	9.1347E 00	-4.4928E-01	-4.2412E 00	3.5863E-01
7.0563E 00	-5.1117E-01	-2.8145E 00	2.0255E-01	8.6450E-01	-5.2861E-02	-1.4423E 00	7.0455E-02	5.7791E-01	-2.7942E-02
ROW = 5									
1.0078E 01	-1.6108E 00	-1.2765E 01	1.8001E 00	2.6503E 00	-5.5055E-01	-8.5560E 00	1.7205E 00	2.3992E 01	-2.4848E 00
-1.5403E 01	4.8785E-01	1.3034E 01	-1.4058E 00	-1.6791E 01	1.5384E 00	3.7333E 00	-4.9435E-01	-1.4290E 00	8.3685E-02
1.3913E 00	-6.4131E-03	4.0722E-02	-1.8297E-02	7.7461E-01	-7.5140E-02	-1.0188E 00	7.6932E-02	2.4287E-01	-2.2045E-02
ROW = 6									
-9.0771E-01	-1.0041E-01	1.5116E 01	-1.2715E 00	-1.4266E 01	7.2570E-01	-3.7901E 01	9.1132E-01	7.7150E 01	1.3921E 00
-3.9178E 01	-2.3332E 00	-4.6504E 00	2.6633E-01	2.3455E 01	-1.3584E 00	-1.8834E 01	5.4470E-01	8.0051E 00	-1.2563E 00
-1.4800E 01	1.8362E 00	6.7824E 00	-6.0903E-01	-7.8634E-01	1.2896E-01	2.0766E 00	-2.4028E-01	-1.2905E 00	9.1096E-02
ROW = 7									
-7.3981E-01	-1.3193E-01	1.7204E 00	-1.5439E-02	-1.0003E 00	1.1781E-01	-3.5070E 00	1.0425E 00	2.3922E 00	-8.4034E-01
1.2601E 00	3.6017E-02	4.4956E 01	-2.1969E 00	-5.9050E 01	1.5585E 00	1.4070E 01	-5.5225E-01	1.9771E 00	-3.7603E-01
[illegible]	[illegible]	4.0316E 00	[illegible]	1.6092E 00	[illegible]	-1.8284E 00	[illegible]	1.4209E-01	9.4890E-03

```
ROW = 8
  1.3463E 00 -4.1179E-01 -2.9841E 00  7.7756E-01  1.6387E 00 -3.4905E-01  4.8076E 00 -5.4211E-01 -4.6561E 00  3.2834E-0[illegible]
 -1.7116E-01 -9.5724E-03 -4.6664E 00  9.0596E-01  2.0278E 01 -1.4472E 00 -1.5597E 01  1.3910E-01  6.0076E 00 -4.9008E-0[illegible]
 -9.6039E 00  4.8225E-01  3.5874E 00 -6.5007E-02 -5.4068E-01  6.6484E-02  1.6391E 00 -9.4963E-02 -1.0974E 00  7.9663E-03

ROW = 9
  1.2453E 01 -3.0610E 00 -1.7128E 01  3.8544E 00  4.6039E 00 -1.1756E 00 -5.5658E 00  1.3376E 00  1.6720E 01 -2.5245E 00
 -1.1152E 01  9.6065E-01 -4.7184E 01  1.1026E 00  1.0416E 02  4.3155E-01 -5.6936E 01 -1.9092E 00  9.9536E 00 -5.0030E-01
 -1.0645E 01 -3.2871E-01  6.6407E-01  5.4069E-01  3.2913E-01 -3.5068E-01  1.7828E 00  5.4742E-01 -2.1151E 00 -2.7173E-01

ROW =10
  4.3502E 00 -5.7173E-01 -5.8496E 00  6.1172E-01  1.4878E 00 -1.6821E-01 -1.6510E 01  1.8200E 00  2.4255E 01 -2.2132E 00
 -7.7233E 00  7.4115E-01  3.2814E 01 -2.6682E 00 -5.0245E 01  3.3371E 00  1.7414E 01 -1.2254E 00  9.1334E 00  7.9664E-01
 -3.9528E 00 -1.8736E 00 -5.1726E 00  6.1488E-01  1.0502E 01 -7.7011E-01 -1.6618E 01  1.0229E 00  6.1116E 00 -3.8930E-01

ROW =11
  1.4089E 00 -2.7444E-01 -1.7376E 00  2.8224E-01  3.2027E-01 -6.2748E-02 -1.2443E 00  1.8094E-01  1.0949E 00 -1.28[illegible]E-01
  1.5627E-01  1.2526E-02  5.3944E 00 -5.6027E-01 -4.5372E 00  4.1980E-01 -8.7177E-01 -1.0317E-01 -4.1597E 00  4.2889E-01
  1.6918E 01 -6.4243E-01 -1.2751E 01 -5.2439E-02  6.8391E 00 -5.1972E-01 -8.4363E 00  5.3208E-01  1.5904E 00 -1.6374E-01

ROW =12
 -4.2925E-01 -7.4189E-02 -4.0901E-01  4.0326E-01  8.4808E-01 -2.6767E-01  9.5629E 00 -1.6658E 00 -1.4331E 01  1.9907E 00
  4.7321E 00 -5.3532E-01 -7.7062E 00  8.4641E-01  2.4004E 01 -1.8206E 00 -1.6107E 01  6.6248E-01 -3.5878E 01  6.2569E-01
  8.1322E 01  4.9875E-01 -4.5419E 01 -1.4175E 00  6.6535E 00 -1.1056E 00 -4.9092E-01  1.0513E 00 -6.1849E 00 -3.0807E-01

ROW =13
 -3.5710E 00  2.5335E-01 -7.7648E 00  1.4075E 00  1.1404E 01 -9.1186E-01  2.4742E 00 -4.8814E-01  5.4340E 00 -5.7632E-01
 -7.9653E 00  5.3625E-01 -1.4234E 01  2.5766E 00  1.6146E 01 -2.7483E 00 -1.8464E 00  6.8874E-01  3.2566E 01 -3.1586E 00
 -4.7524E 01  3.9586E 00  1.4923E 01 -1.3763E 00  4.3377E 01 -2.2437E 00 -5.4863E 01  1.9480E 00  1.1461E 01 -5.8647E-01

ROW =14
  1.9916E-01 -2.3901E-01 -3.4365E 00  6.7248E-01  3.2440E 00 -2.7910E-01 -2.4803E 00  6.6302E-01  6.1036E 00 -1.1614E 00
 -3.6209E 00  4.2679E-01  3.3118E 00 -6.8924E-01 -6.5568E 00  1.0454E 00  3.2383E 00 -3.4629E-01  1.8442E 00 -1.8229E-02
  3.6267E 00 -3.3586E-01 -5.4774E 00  1.2053E-01 -1.2027E 01  8.7354E-01  3.1631E 01 -1.0362E 00 -1.9591E 01 -4.8667E-02

ROW =15
  2.2454E 00 -5.7706E-01 -3.8351E 00  8.5636E-01  1.5819E 00 -3.0787E-01 -6.8436E 00  1.5889E 00  1.1028E 01 -2.2217E 00
 -4.1598E 00  7.3725E-01  1.4633E 01 -2.3999E 00 -2.2895E 01  3.1263E 00  8.2255E 00 -9.6423E-01 -1.2193E 01  8.7897E-01
  3.1987E 01 -1.5442E 00 -1.9795E 01  4.2893E-01 -4.8770E 01  1.6843E 00  9.8550E 01 -9.3946E-01 -4.9750E 01 -7.7787E-01
```

Sample Problem 3.

A 45° delta wing is analyzed at M = 2.0, f = 5.5 cps and a = 1116.87 ft/sec (sea level). The trailing surface is removed from the analysis by setting X(5) = X(4) = X(3). The wing geometry and AIC station locations are shown in Figure 6.9. Six boxes were specified along wing root. The Mach box overlay has 34 boxes. Input parameters are summarized below and a listing of the input data cards and computer output follows.

X(1) = 0.0'	X(2) = 2.0'	X(3) = 2.0'	X(4) = 2.0'	X(5) = 2.0'
Y(1) = 0.0'	Y(2) = 0.0'	Y(3) = 2.0'		

SOUND = 1116.87 ft/sec	Acoustic velocity (sea level)
NMACH = 1	Number of Mach numbers
KF = 0	Input frequency
NFREQ = 1	Number of frequencies
NBW = 6	Number of chordwise boxes on wing
LPUNCH = 1	Punch AIC matrix for wing on cards
FMACH (1) = 2.0	Mach number
FREQ (1) = 5.5	Frequency (cps)
NXWING = 3	Number of chordwise AIC stations on wing
NYWING = 4	Number of spanwise AIC stations on wing
NXCS = 0	Number of chordwise AIC stations on control surface
NYCS = 0	Number of spanwise AIC stations on control surface

YAIC(1,W) = 0.2'	YAIC(2,W) = 0.6'	YAIC(3,W) = 1.0'
YAIC(4,W) = 1.4'		

XAIC(1,1,W) = 0.560'	XAIC(1,2,W) = 1.100'	XAIC(1,3.W) = 1.640'
XAIC(2,1,W) = 0.880'	XAIC(2,2,W) = 1.300'	XAIC(2,3,W) = 1.720'
XAIC(3,1.W) = 1.200'	XAIC(3,2,W) = 1.500'	XAIC(3,3,W) = 1.800'
XAIC(4,1.W) = 1.520'	XAIC(4,2.W) = 1.700'	XAIC(4,3.W) = 1.880'

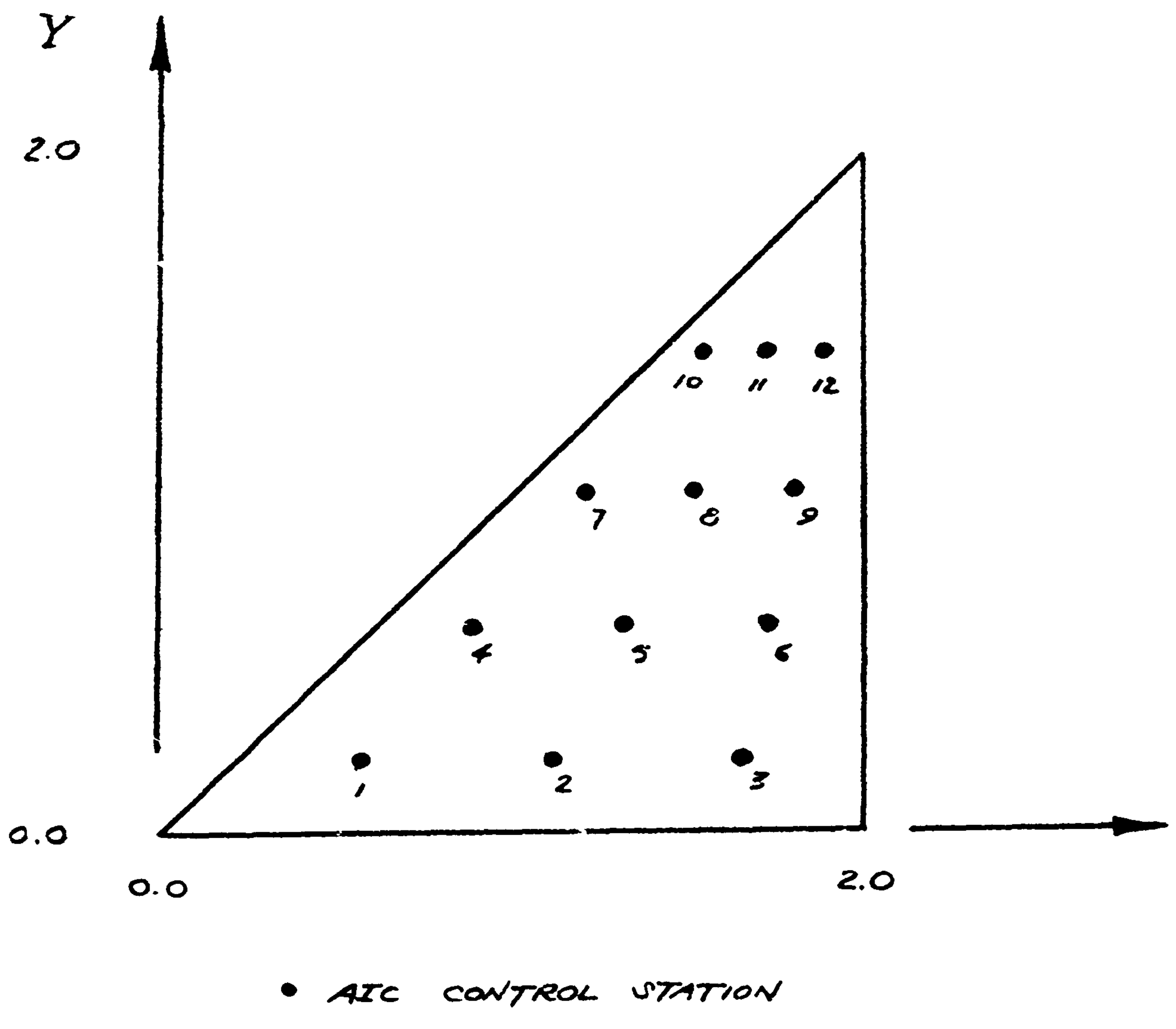


FIGURE 6.9 - SUPERSONIC SAMPLE PROBLEM 3.

```
                         DATA CARD COLUMN NUMBER
********************************************************************************
         1111111111222222222233333333334444444444555555555566666666667777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
********************************************************************************



0.0       2.0       2.0       2.0       2.0
0.0       0.0       2.0       1116.87
         1         0         1         6         1
2.0                                                           MACH NO.
5.5                                                           FREQ
         3         4         0         0
0.200     0.600     1.000     1.400                           Y-WING
0.560     1.100     1.640     0.880     1.300     1.720       X-WING
1.200     1.500     1.800     1.520     1.700     1.880       X-WING



********************************************************************************
         1111111111222222222233333333334444444444555555555566666666667777777778
12345678901234567890123456789012345678901234567890123456789012345678901234567890
********************************************************************************
                         DATA CARD COLUMN NUMBER
```

FIGURE 6.10 - LISTING OF INPUT DATA CARDS FOR SUPERSONIC SAMPLE PROBLEM 3.

HUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM

FLIGHT CONDITIONS AND GEOMETRY

MACH NUMBER = 2.00000   SPEED OF SOUND = 1116.870 L/T   RHO= 1.00

	WING	TAIL
L.E. STATION (L)	0.	2.000
ROOT CHORD (L)	2.000	0.
L.E. SPAN (L)	0.	2.000
T.E. SPAN (L)	2.000	2.000
TIP CHORD (L)	0.	0.
TOTAL AREA (L*L)	4.000	0
CHORDWISE BOXES	6	0
SPANWISE BOXES	11	11

TOTAL CHORDWISE BOXES = 6   BOX CHORD = 3.636364E-01 L   BOX SPAN = 2.099465E-01 L

```
MAP OF MACH BOX OVERLAY ON      S
WING, TAIL, AND DIAPHRAGM       SSS
        ($) - WING              SSSSS
        ($) - TAIL              SSSSSSS
        (,) - WAKE              SSSSSSSS
        (.) - DIAPHRAGM         SSSSSSSSSS
```

HUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM (CONT-D)

AIC COLLOCATION STATION COORDINATES ON THE WING

YAIC	XAIC VALUES--		
0.200000E 00	0.560000E 00	0.110000E 01	0.164000E 01
0.600000E 00	0.880000E 00	0.130000E 01	0.172000E 01
0.100000E 01	0.120000E 01	0.150000E 01	0.180000E 01
0.140000E 01	0.152000E 01	0.170000E 01	0.188000E 01

HUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM (CONT-D)

OSCILLATORY FREQUENCY (CPS) 5.50000E 00

REFERENCE CHORD 1.00000E 00

REDUCED FREQUENCY (REF. CHORD) 1.54707E-02

REDUCED VELOCITY (REF. CHORD) 6.46383E 01

FREE STREAM MACH NUMBER 2.00000E 00

FREE STREAM VELOCITY 2.23374E 03

DENSITY 1.00

DYNAMIC PRESSURE (1/2*RHO*VEL**2) 2.49480E 06

AERODYNAMIC INFLUENCE COEFFICIENTS

RL	IM	RL	IM	RL	IM	RL	IM	RL	IM
ROW = 1									
1.0441E 03	-3.2339E 00	-1.4429E 03	-2.0007E 00	3.9882E 02	-4.3389E-01	-9.3514E 01	-1.1029E 00	8.0287E 01	3.0622E 00
1.3215E 01	-6.5403E-01	9.2352E 01	-1.4617E-01	-1.1997E 02	-5.5718E-01	2.7620E 01	1.1835E-02	-1.0225E 01	1.5605E-02
1.3273E 01	6.2758E-02	-3.0485E 00	-1.6137E-03						
ROW = 2									
7.0303E 02	-1.4918E 00	-6.9225E 02	-3.3729E 00	-1.0763E 01	-1.2428E 00	2.1712E 02	-5.3096E-01	-4.4593E 02	1.1718E 00
2.2883E 02	-2.5374E-01	-6.8500E 01	1.2637E 00	1.5028E 02	-1.9723E 00	-8.1782E 01	4.5503E-01	7.4313E 00	-1.3721E-01
-1.6419E 01	2.1469E-01	8.9871E 00	-4.9075E-02						
ROW = 3									
-3.7155E 01	-7.9149E-01	9.5114E 02	3.5863E 00	-8.1395E 02	-9.3385E 00	9.6132E 02	-9.6509E 00	-1.6529E 03	1.3720E 01
6.9160E 02	-5.7192E 00	-2.3005E 02	6.9199E 00	3.8197E 02	-8.3093E 00	-1.5190E 02	1.7223E 00	2.5215E 01	-7.4748E-01
-4.2149E 01	8.9703E-01	1.6931E 01	-1.8519E-01						
ROW = 4									
2.4510E 02	-4.1041E 00	-6.2173E 02	1.1052E 01	3.7666E 02	-5.4068E 00	9.2832E 02	-3.6264E 0	-9.9725E 02	-5.7844E 00
6.8901E 01	2.8683E 00	5.4654E 01	-1.7794E 00	-2.4813E 02	4.8540E 00	1.5348E 02	-2.2106E 00	-1.2385E 01	1.7618E-01
2.9583E 01	-4.9086E-01	-1.71[illegible] 01	2.2666E-01						
ROW = 5									
3.5916E 02	-5.8558E 00	-4.0957E 02	4.2036E 00	5.0377E 01	-1.0644E 00	-3.7919E 01	7.0758E 00	4.7535E 02	-1.0708E 01
-4.3740E 02	1.3620E 00	1.9298E 02	-1.7167E 00	-1.9235E 02	7.0793E-01	-6.3365E-01	-2.1606E-01	-1.0272E 01	9.0670E-02
7.6467E 00	-9.4739E-03	2.0258E 00	6.9522E-03						
ROW = 6									
1.0741E 02	-1.0037E 00	[illegible].0531E 02	-2.1791E 00	-2.1275E 02	1.0037E 00	-7.9278E 02	6.1951E 00	1.7983E 03	-1.0533E 00
-1.0054E 03	-6.2873E [illegible]	2.71[illegible]E 02	-6.1429E 00	-1.3636E 02	6.7967E 00	-1.3474E 02	-2.7963E 00	4.5668E 01	-5.3785E-01
-7.9710E 01	6.2112E-01	3.4041E 01	-6.8402E-02						
ROW = 7									
-2.1046E 02	2.5294E 00	3.9182E 00	2.5712E 00	2.0658E 02	-1.7346E 00	-6.0668E 02	-4.0748E 00	-6.2339E 02	4.9870E-01
1.6691E 01	-7.5464E-02	7.4082E 02	-3.6465E 00	-6.9332E 02	2.4040E 00	1.5249E 02	-1.1923E 00	1.5203E 02	-1.2272E 00

```
-2.6795E 02  1.9165E 00  1.1591E 02 -8.5176E-01

ROW = 8
  6.5256E 01 -2.7413E 00 -1.9163E 02  5.3029E 00  1.2637E 02 -1.9813E 00  3.4384E 01  6.7329E-01  1.5790E 02 -3.9334E 00
 -1.9229E 02  1.5753E 00  5.783[illegible]E 01 -3.9152E-01  3.9567E 02 -1.5165E-01 -4.5350E 02 -1.[illegible]167E 00  1.2564E 02 -9.5576E-01
 -1.3196E 02  8.2621E-01  6.3126E 00 -2.7435E-01

ROW = 9
  2.0509E 02 -6.4651E 00 -2.6614E 02  7.2924E 00  6.1018E 01 -2.6149E 00 -1.7688E 02  3.2964E 00  5.1066E 02 -6.7317E 00
 -3.3378E 02  2.3614E 00 -9.5149E 02  1.8504E 00  2.3845E 03  1.1171E 00 -1.4330E 03 -5.0682E 00  8.5096E 01 -1.2034E 00
  8.0034E 01  7.2385E-01 -1.6513E 02 -2.8514E-01

ROW =10
  6.4167E 01 -2.7347E 00 -2.8997E 02  5.9661E 00  2.2561E 02 -1.7726E 00 -2.9849E 02  6.4422E 00  5.2420E 02 -8.3986E 00
 -2.2569E 02  2.0556E 00  1.0155E 03 -9.6264E 00 -1.4241E 03  9.7377E 00  4.0854E 02 -2.5068E 00 -3.2189E 02  2.7458E 00
  1.0158E 03 -4.5361E 00 -6.939[illegible]E 02  5.9168E-01

ROW =11
  3.1375E 01 -1.6121E 00 -1.3583E 02  3.6458E 00  1.0445E 02 -1.4152E 00 -5.0762E 01  1.1190E 00  1.5641E 02 -2.0919E 00
 -1.0565E 02  6.5683E-01  3.8305E 02 -4.5357E 00 -5.2318E 02  3.9404E 00  1.4012E 02 -6.3778E-01 -6.3864E 02  1.6386E 00
  1.9168E 03 -3.2557E 00 -1.2782E 03 -1.0700E-01

ROW =12
  7.1618E-01  1.0364E 00 -2.2171E 01 -2.0325E 00  2.1469E 01  1.1374E 00  1.5615E 02 -1.9620E 01 -1.9336E 02  5.1634E 01
  3.7255E 01 -3.2599E 01 -1.4524E 02  4.0777E 01  3.7085E 02 -1.1813E 02 -2.2564E 02  7.6702E 01 -4.8480E 02 -3.7054E 01
  1.5952E 03  1.0792E 02 -1.1105E 03 -7.2485E 01
```

PART VI - SECTION B4.0

LISTING OF SUPERSONIC AIC
COMPUTER PROGRAM

```
CDRIVE      DRIVE
      COMPLEX CZERO,VPIC,SS,PHIW,SPHI,PHI,PHITE,DPHI,EXF,W,F,AIC,Z
      DIMENSION F(45,45),W(45,45),S(45,45),R(45,45),
     1          TEMP(45,45),B(45,45),C(45,45),T(45,45),TM(45,45),
     2          TI(45,45),TR(45,45)
      COMMON/C1/KHOX(1000),XF(5),YF(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH,KF
      COMMON/C3/VPIC(2025),SS(2025),PHIW(50),SPHI,CZERO,PHI,PHITE,DPHI
      COMMON/C4/MOR(50),NBL(50),KC(50),KL(28),BSL(20),DXE(2),TPI,U
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,FKR,NP,MP,NB,NBOX,KODE,MODE,NBW,NBT
      COMMON/C6/XL,NS,K,J,IFR,TWL,RHO
      COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXCS
      COMMON/C8/NXWING,NYWING,NXCS,NYCS
      COMMON/C9/AIC(45,45),AR(3)
      EQUIVALENCE (C,S,R),(VPIC,W,B),(SS,F,TM),(AIC,TEMP)
    1 CALL DAIN
      IF (NMODE .LE. 45) GO TO 5
      WRITE (6,8)
    8 FORMAT (1H1,5X,50H NUMBER OF AIC STATIONS EXCEEDS MAX ALLOWABLE (4
     15)/5X,16H CASE TERMINATED)
      GO TO 1
    5 CONTINUE
      DO 1000 MACH=1,NMACH
      EM=FMACH(MACH)
      IF (EM .LT. 1.1) GO TO 1000
      CALL CODE
      TOB=TWL/BETA
      CALL POUT(1)
      CALL POUT(2)
      NTRS=0
      DO 7 I=1,NBS
    7 NTRS=NTRS+NXBX(I)+NXBXCS
      IF (NTRS .LE. 45) GO TO 13
      WRITE (6,14)
   14 FORMAT(1H1,5X,48H NUMBER OF MACH BOXES EXCEEDS MAX ALLOWABLE (45)
     1/5X,16H CASE TERMINATED)
      GO TO 1
   13 CONTINUE
      U=AS*EM
      TPU=TPI/U
      RFM=DX*(EM/BETA)**2
      CALL TRAMP (2,NTRS,NTCS,S,R,C,B,T,TR,TI,TM)
      DO 550 I=1,NTRS
      DO 550 J=1,NTCS
  550 TEMP(I,J)=TR(I,J)
      CALL TRAMP (1,NTRS,NTCS,S,R,C,B,T,TR,TI,TM)
      DO 560 I=1,NTRS
      DO 560 J=1,NTCS
  560 TR(I,J)=TEMP(I,J)
      NMODE=NTCS
      DO 900 IFR=1,NFREQ
      IF (KF .EQ. 1) FREQ(IFR)=FREQ(IFR)*FMACH(MACH)*AS/(TPI*X1*0.5)
      FK=FREQ(IFR)*TPU
      FKB=FK*RFM
      FKR=FK*X1/2.0
      CALL CAFI
      ARG=FK*DX
      EXF=CMPLX(COS(ARG),-SIN(ARG))
      DO 900 MODE=1,NMODE
      X=0.5*DX
      NH=1
```

```
      DO 200 NP=1,NBOX
      KD=KBOX(NB)
      NS=1
      GO TO (70,60,70,60,60,70,70),KD
   60 NS=2
   70 MB=MOB(NP)
      Y=0.0
      DO 100 MP=1,MB
      KODE=KBOX(NB)
      SPHI=CZERO
      IF (NP .GT. 1) CALL PHIB
      SPHI=SPHI*DY
      PHI=CZERO
      GO TO (40,40,40,40,40,20,30), KODE
   20 SPHI=SPHI-PHIW(MP)
      PHI=PHIW(MP)
      PHIW(MP)=PHIW(MP)*EXF
      GO TO 50
   30 IF (KD .LT. 6) GO TO 40
   50 SS(NB)=-SPHI/VPIC/DY
      GO TO 90
   40 IF (NS .EQ. 2) GO TO 45
      IR=0
      DO 21 IL=1,MP
   21 IR=IR+NXBX(IL)
      IR=IR+NP-NXBX(1)
      GO TO 26
   45 IR=0
      DO 22 IL=1,NBS
   22 IR=IR+NXBX(IL)
      DO 23 IL=1,MP
   23 IR=IR+NXBXCS
      IR=IR-NBOX+NP
   26 SR=FM*AS*TR(IR,MODE)
      SI=TPI*FREQ(IFR)*TI(IR,MODE)
      SS(NB)=CMPLX(SR,SI)
      IF (KD .LT. 6) SS(NB)=SS(NB)-ARLF(TOB)*(SS(NB)+SPHI/VPIC/DY)
      IF (KODE .GE. 6) GO TO 90
      PHI=SPHI+SS(NB)*VPIC*DY
      IF (KODE .EQ. 3) PHIW(MP)=PHI*EXF
      IF (NP .EQ. NBOX-1) PHIW(MP)=PHI
      IF (NP .EQ. NBOX) PHITE=PHI+(PHI-PHIW(MP))*DXE(5)
      GO TO (128,121,128,121,121,127,127),KODE
  128 IC=0
      DO 122 IL=1,MP
  122 IC=IC+NXBX(IL)
      IC=IC+NP-NXBX(1)
      GO TO 126
  121 IC=0
      DO 123 IL=1,NBS
  123 IC=IC+NXBX(IL)
      DO 124 IL=1,MP
  124 IC=IC+NXBXCS
      IC=IC-NBOX+NP
  126 AIC(IC,MODE)=PHI
  127 CONTINUE
   90 CONTINUE
      NB=NB+1
      KD=KODE
  100 Y=Y+DY
  200 X=X+DX
```

```
  500 CONTINUE
      CALL SD2 (S,R,C,B,T,TR,TM)
      DO 701 I=1,NTRS
      DO 701 J=1,NTRS
      SI=0.0
      IF (I .EQ. J) SI=TPI*FREQ(IFR)/(FM*AS)
      SR=TM(I,J)
  701 W(I,J)=CMPLX(SR,SI)
      DO 702 I=1,NTRS
      DO 702 J=1,NTCS
      F(I,J)=(0.0,0.0)
      DO 702 K=1,NTRS
  702 F(I,J)=F(I,J)-W(I,K)*AIC(K,J)
      ZCON=(4.0*DX*DY*FM*AS)/((TPI*FREQ(IFR))**2*(YE(3)-YE(1))*
     1(XF(3)-XF(1))**2)
      CALL FORCE (R)
      DO 708 I=1,NTCS
      DO 708 J=1,NTCS
      AIC(I,J)=(0.0,0.0)
      DO 708 K=1,NTRS
      Z=CMPLX(C(I,K)*ZCON,0.0)
  708 AIC(I,J)=AIC(I,J)-Z*F(K,J)
      CALL POUT(3)
      IF (LPUNCH .GT. 0) CALL POUT(4)
  900 CONTINUE
 1000 CONTINUE
      GO TO 1
      END
```

```
CDAIN        DAIN
      SUBROUTINE DAIN
      COMPLEX CZERO,VPIC,SS,PHIW,SPHI,PHI,PHITE,DPHI
      COMMON/C1/KBOX(1000),XE(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH,KF
      COMMON/C3/VPIC(2025),SS(2025),PHIW(50),SPHI,CZERO,PHI,PHITE,DPHI
      COMMON/C4/MOB(50),NBL(50),KC(50),KL(28),BSL(20),DXE(7),TPI,U
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,MP,NB,NBOX,KODE,MODE,NBW,NBT
      COMMON/C6/XL,NS,K,J,IFR,TWL,RHO
      COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXCS
      COMMON/C8/NXWING,NYWING,NXCS,NYCS
      READ(5,11) (XE(I),I=1,5)
      READ(5,11) (YE(I),I=1,3),AS
      READ(5,12) NMACH,KF,NFREQ,NBW,LPUNCH
      READ(5,11) (FMACH(I),I=1,NMACH)
      READ(5,11) (FREQ(I),I=1,NFREQ)
      NSURF=2
      IF(XE(4).LT.XE(5)) GO TO 10
      NSURF=1
      XE(4)=XE(3)
      XE(5)=XE(3)
   10 READ (5,12) NXWING,NYWING,NXCS,NYCS
      READ (5,11) (YAIC(I,1),I=1,NYWING)
      IF (NXCS .NE. 0) READ (5,11) (YAIC(I,2),I=1,NYCS)
      READ (5,11) ((XAIC(I,J,1),I=1,NXWING),J=1,NYWING)
      IF (NXCS .NE. 0) READ (5,11) ((XAIC(I,J,2),I=1,NXCS),J=1,NYCS)
      RHO=1.0
      NMODE=NXWING*NYWING+NXCS*NYCS
   11 FORMAT(6E12.8)
   12 FORMAT(6I12)
      RETURN
      END
```

```
CCODE        CODE
      SUBROUTINE CODE
      COMPLEX CZERO,VPIC,SS,PHIW,SPHI,PHI,PHITE,DPHI
      COMPLEX AIC
      COMMON/C1/KHOX(1000),XF(5),YF(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH,KF
      COMMON/C3/VPIC(2025),SS(2025),PHIW(50),SPHI,CZERO,PHI,PHITE,DPHI
      COMMON/C4/MOR(50),NBL(50),KC(50),KL(28),BSL(20),DXE(7),TPI,U
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,MP,NB,NBOX,KODE,MODE,NBW,NBT
      COMMON/C6/XL,NS,K,J,IFR,TWL,RHO
      COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXCS
      COMMON/C8/NXWING,NYWING,NXCS,NYCS
      COMMON/C9/AIC(45,45),AR(3)
      BETA = SQRT((FM * FM)-1.0)
      X1 = XF(3) - XF(1)
      X2 = XF(3) - XF(2)
      X3 = XF(4) - XF(1)
      X4 = XF(5) - XF(4)
      X5 = XF(5) - XF(1)
      Y1 = YF(2) - YF(1)
      Y2 = YF(3) - YF(1)
      IF(X2.GT.X1.OR.X1.GT.X3.OR.X3.GT.X5.OR.X2.LT.0.0) GO TO 50
      IF(Y1.GT.Y2.OR.Y1.LT.0.0) GO TO 50
      TWL = 0.0
      IF(Y2.NE.Y1)  TWL = (X1 - X2) / (Y2 - Y1)
      AR(1) =        (Y2*(X2+X1) - Y1 * (X2-X1))
      AR(2) = Y2*X4*2.0
      AR(3) = AR(1) + AR(2)
   10 DX = X1/(FLOAT(NBW) -0.5)
      IF (50.0 * DX .GT. X5) GO TO 20
   15 NBW = NBW+1
      GO TO 10
   20 DY = DX/BETA
      YN1 = Y1/DY
      YN2 = Y2/DY
      XNL = YN2 - (X1-X2) / DX
      XNT = YN2 + X5/DX
      XNLE = X3/DX
      XNTE=X5/DX
      NBOX=XNTE+0.500001
      NBS = Y2/DY + 1.0
      NBT = X4/DX + 0.5
      DXE(1) = 1.0
      DXE(2) = 1.0
      DXE(3) = 0.5
      DXE(4) = AINT(XNLE + 0.5) - XNLE
      DXE(5)=XNTE-FLOAT(NBOX-1)
      DXE(6) = 0.0
      DXE(7) = 0.0
      X = 0.5 * DX
      FH = 0
      NBC MIN1(AMAX1(XNL+FLOAT(NBOX)-0.5,YN1+FLOAT(NBOX)-0.5),XNT-FLOAT
     1          (NBOX)+0.5)+1
      DO 60 II=1,NBC
   60 NXBX(II)=0
      NXBXCS=0
      DO 40 NP = 1,NBOX
      XN = FLOAT(NP) - 0.5
      YW = YN2
      IF (TWL .GT. 0.0) YW=AMIN1(YW,YN1+XN/(TWL/BETA))
      IF(X.GT.XF(2)) GO TO 24
```

```
      MB = MIN1(AMAX1(YW,XN+YN1),XNT-XN)+1
      GO TO 28
   24 MB = MIN1(AMAX1(XNL+XN,XN+YN1),XNT-XN)+1
   28 MOR(NP) = MB
      KODE = 1
      IF (NP .EQ. NBW) KODE =3
      IF (NSURF .EQ.1) GO TO 29
      IF (X .GT. X1) KODE =6
      IF(NP.EQ.NBW)KODE=3
      IF (X .GT. X5    ) KODE =4
      IF (X .GT. X5+DX) KODE=2
      IF (NP .EQ. NBOX) KODE =5
   29 IF(NB+MB.GT.2000) GO TO 15
      NBI(NP) = NB
      DO 30 MP = 1,MB
      YN = MP-1
      NB = NB + 1
      IF (YN .GT. YW) KODE =7
      IF (KODE .EQ. 1 .OR. KODE .EQ. 3) GO TO 70
      GO TO 71
   70 NXBX(MP)=NXBX(MP)+1
   71 CONTINUE
      IF (MP .NE. 1) GO TO 73
      IF (KODE .EQ. 2 .OR. KODE .EQ. 4 .OR. KODE .EQ. 5) GO TO 72
      GO TO 73
   72 NXBXCS=NXBXCS+1
   73 CONTINUE
      Y=DY*FLOAT(MP)-0.5*DY
      IF (KODE .EQ. 1 .OR. KODE .EQ. 3) NYBX(NP)=MP
   30 KBOX (NB    ) = KODE
   40 X = X+DX
      RETURN
   50 CALL EXIT
      RETURN
      END
```

```
CPOUT         POUT
      SUBROUTINE POUT(IND)
      COMPLEX CZERO,VPIC,SS,PHIW,SPHI,PHI,PHITE,DPHI
      COMPLEX W,AIC
      DIMENSION SW(5,6),SURF(2,3),COD(7),C(50)
      COMMON/C1/KBOX(1000),XE(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH,KF
      COMMON/C3/VPIC(2025),SS(2025),PHIW(50),SPHI,CZERO,PHI,PHITE,DPHI
      COMMON/C4/MOR(50),NBL(50),KC(50),KL(28),BSL(20),DXE(7),TPI,U
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,MP,NB,NBOX,KODE,MODE,NBW,NBT
      COMMON/C6/XL,NS,K,J,IFR,TWL,RHO
      COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXCS
      COMMON/C8/NXWING,NYWING,NXCS,NYCS
      COMMON/C9/AIC(45,45),AR(3)
      DATA (SW(1,I),I=1,6)/26HMAP OF MACH BOX OVERLAY ON,
     1                     26HWING, TAIL, AND DIAPHRAGM ,
     2                     26H         (S) - WING       ,
     3                     26H         ($) - TAIL       ,
     4                     26H         (.) - WAKE       ,
     5                     26H         (.) - DIAPHRAGM  /
      DATA (SURF(1,I),I=1,3)/8HWING    ,8HTAIL    ,1)HWING + TAIL /
      DATA COD/1HS,1H$,1HS,1H$,1H$,1H,,1H./
      GO TO (10,20,30,40), IND
   10 WRITE(6,11)EM,AS,RHO,XE(1),XE(4),X1,X4,Y1,Y2,Y2,Y2,X2,X4,AR(1),
     1 AR(2),NBW,NBT,NBS,NBS
   11 FORMAT(1H1///// 32X,43HHUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM
     1 ///37X,30HFLIGHT CONDITIONS AND GEOMETRY/1H0//15X, 15HMACH NUMBER
     2 =,F8.5,4X,16HSPEED OF SOUND =F10.3,4H L/T,4X,4HRHO=,F6.2 //1H0/
     X54X,4HWING,18X,
     3 4HTAIL///22X,16HL.E. STATION (L),2F22.3//22X,16HROOT CHORD   (L),
     4 2F22.3// 22X,16HL.E. SPAN    (L),2F22.3//22X,16HT.E. SPAN    (L),
     5 2F22.3// 22X,16HTIP CHORD    (L),2F22.3//22X,16HTOTAL AREA (L*L),
     6 2F22.3// 22X,16HCHORDWISE BOXES ,I19,I22//22X,
     716HSPANWISE BOXES  ,I19,I22)
      WRITE(6,12)NBOX,DX,DY
   12 FORMAT(1H0/,11X,23HTOTAL CHORDWISE BOXES =,I3, 5X,11HBOX CHORD =,
     1 1P1E12.5,2H L, 5X,10HBOX SPAN =,1P1E12.5,2H L/    )
      WRITE(6,91)
   91 FORMAT(1H1///// 28X,51HHUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM
     1(CONT-D)  ////)
      NB = 1
      DO 17 NP = 1,NBOX
      MB = MOR(NP)
      IF(MB.GT.50)  GO TO 800
      DO 13 MP = 1,MB
      K = KBOX(NB)
      C(MP) = COD(K)
   13 NB = NB + 1
      IF(NP.GT.6) GO TO 15
      WRITE(6,14)(SW(I,NP),I=1,5),(C(MP),MP=1,MB)
   14 FORMAT(10X,5A6,50A1)
      GO TO 17
   15 WRITE(6,16) (C(MP),MP=1,MB)
   16 FORMAT(40X,50A1)
   17 CONTINUE
      GO TO 1000
  800 WRITE(6,801)
  801 FORMAT(9X,52HWHEN MOB EXCEEDS 50 THE MAP PRINTING IS DISCONTINUED
     1//1H0,48H            CALCULATIONS PROCEED IN NORMAL MANNER       )
      GO TO 1000
   20 NYS=NYWING
```

```
      NXS=NXWING
      DO 200 NS=1,2
      WRITE (6,201) (SURF(I,NS),I=1,2)
  201 FORMAT(1H1,28X,51HHUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM (CONT
     1-D) //////28X,43HAIC COLLOCATION STATION COORDINATES ON THE 2A6/1H0
     2,19X, 4HYAIC, 13X,13HXAIC VALUES--)
      DO 202 IY=1,NYS
      YC=YAIC(IY,NS)
  202 WRITE (6,203) YC,(XAIC(IX,IY,NS),IX=1,NXS)
      NYS=NYCS
      NXS=NXCS
      IF (NYS .EQ. 0 .OR. NXS .EQ. 0) GO TO  205
  200 CONTINUE
  205 RETURN
  203 FORMAT (1H0,12X,5E17.6/(1H ,29X,4E17.6))
   30 VEL=EM*AS
      Q=0.5*RHO*VEL**2
      RV=1.0/EKR
      BR=X1/2.0
      WRITE (6,220) FREQ(IFR),BR,EKR,RV,EM,VEL,RHO,Q
  220 FORMAT(1H1,31X,51HHUGHES AIRCRAFT CO. SUPERSONIC AIC PROGRAM (CONT
     1-D)////9X,28H OSCILLATORY FREQUENCY (CPS),4X,1PE12.5,/1H0,9X,15HRE
     2FERENCE CHORD,4X,1PE12.5,/1H0,9X,30HREDUCED FREQUENCY (REF. CHORD)
     3,4X,1PE12.5,/1H0,9X,29HREDUCED VELOCITY (REF. CHORD),4X,1PE12.5,
     4/1H0,9X,23HFREE STREAM MACH NUMBER,4X,1PE12.5,/1H0,9X,20HFREE STRE
     5AM VELOCITY,4X,1PE12.5,/1H0,9X,7HDENSITY,4X,0PF5.2,/1H0,9X,33HDYNA
     6MIC PRESSURE (1/2*RHO*VEL**2),4X,1PE12.5,////)
      WRITE (6,221)
  221 FORMAT(///35X,34HAERODYNAMIC INFLUENCE COEFFICIENTS,//5X,2HRL,10X,
     12HIM,10X,2HRL,10X,2HIM,10X,2HRL,10X,2HIM,10X,2HRL,10X,2HIM,10X,2HR
     2L,10X,2HIM,/)
      NROWS=NYWING*NXWING+NYCS*NXCS
      DO 222 NROW=1,NROWS
      WRITE (6,223)NROW
      WRITE (6,224) (AIC(NROW,NCOL),NCOL=1,NROWS)
  223 FORMAT (/ 5HROW = I2)
  224 FORMAT (1P10E12.4)
  222 CONTINUE
      RETURN
   40 NW=NXWING*NYWING
      NC=NXCS*NYCS
      NT=NW+NC
      NW1=NW+1
      GO TO (81,82,83,84),LPUNCH
   81 CONTINUE
      DO 301 I=1,NW
      PUNCH 85, (AIC(I,J),J=1,NW)
  301 CONTINUE
   85 FORMAT (1P6E12.5)
      RETURN
   82 CONTINUE
      DO 302 I=NW1,NT
      PUNCH 85, (AIC(I,J),J=NW1,NT)
  302 CONTINUE
      RETURN
   83 CONTINUE
      DO 303 I=1,NW
      PUNCH 85, (AIC(I,J),J=1,NW)
  303 CONTINUE
      DO 304 I=NW1,NT
```

```
      PUNCH 85, (AIC(I,J),J=NW1,NT)
  304 CONTINUE
      RETURN
   84 CONTINUE
      DO 305 I=1,NT
      PUNCH 85, (AIC(I,J),J=1,NT)
  305 CONTINUE
 1000 RETURN
      END
```

```
CFORCE      FORCE
      SUBROUTINE FORCE (R)
      DIMENSION R(45,45)
      COMMON/C1/KBOX(1000),XE(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,MP,NB,NBOX,KODE,MODE,NBW,NBT
      COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXCS
      COMMON/C8/NXWING,NYWING,NXCS,NYCS
      MB=NBS
      NMBXW=0
      DO 50 I=1,MB
   50 NMBXW=NMBXW+NXBX(I)
      KROW=NXWING*NYWING+NXCS*NYCS
      KCOL=0
      DO 100 I=1,MB
  100 KCOL=KCOL+NXBX(I)+NXBXCS
      DO 150 I=1,KROW
      DO 150 J=1,KCOL
  150 R(I,J)=0.0
      DO 600 I=1,MB
      NCK=0
      FRB=1.0
      FRT=1.0
      FOF = 1.0
      YR=DY*FLOAT(I)-DY
      II=NYWING-1
      DO 610 III=1,II
      IF (0.5*(YAIC(III,1)+YAIC(III+1,1))-YE(1) .GT. YR-.5*DY) GO TO 630
  610 CONTINUE
      III=NYWING
      GO TO 620
  630 CONTINUE
      IF (YR-0.5*DY .LT. 0.5*(YAIC(III,1)+YAIC(III+1,1))-YE(1) .AND.
     1    YR+0.5*DY .GT. 0.5*(YAIC(III,1)+YAIC(III+1,1))-YE(1)) NCK=1
      IF (NCK .EQ. 0) GO TO 620
      FRB=(0.5*(YAIC(III,1)+YAIC(III+1,1))-YE(1)-YR+0.5*DY)/DY
      FRT=1.0-FRB
  620 NROW=NXWING*(III-1)
      NCOL=0
      DO 650 IIII=1,I
  650 NCOL=NCOL+NXBX(IIII)
      NCOL=NCOL-NXBX(I)
      KK=NXBX(I)
      DO 750 K=1,KK
      DO 700 J=1,NXWING
      IF (XAIC(1,III,1)-XE(1) .GE. (FLOAT(NXBX(1)-NXBX(I)+K)-.5)*DX)
     1GO TO 710
      IF (XAIC(NXWING,III,1)-XE(1) .LE. (FLOAT(NXBX(1)-NXBX(I)+K)-.5)*
     1DX) GO TO 720
      IF (XAIC(J,III,1)-XE(1) .GT. (FLOAT(NXBX(1)-NXBX(I)+K)-.5)*DX)
     1GO TO 730
  700 CONTINUE
  710 NRF=NROW+1
      NCF=NCOL+K
      R(NRF,NCF)=FRB
      IF (I .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*0.5
      IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
      IF (I .EQ. MB) FOF = (YE(3)-YE(1)-(FLOAT(MB)-1.5)*DY)/DY
      IF (I .EQ. MB) R(NRF,NCF)=R(NRF,NCF)*FOE
      GO TO 740
  720 NRF=NROW+NXWING
      NCF=NCOL+K
```

```
      R(NRF,NCF)=FRB
      IF (I .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*0.5
      IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
      IF (I .EQ. MB) FOE = (YE(3)-YE(1)-(FLOAT(MB)-1.5)*DY)/DY
      IF (I .EQ. MB) R(NRF,NCF)=R(NRF,NCF)*FOE
      GO TO 740
  730 R1=XAIC(J,III,1)-XE(1)-(FLOAT(NXBX(1)-NXBX(I)+K)-0.5)*DX
      R3=XAIC(J,III,1)-XAIC(J-1,III,1)
      NRF=NROW+J
      NCF=NCOL+K
      R(NRF,NCF)=(1.0-R1/R3)*FRB
      R(NRF-1,NCF)=(R1/R3)*FRB
      IF (I .EQ. 1) R(NRF,NCF)=0.5*R(NRF,NCF)
      IF (I .EQ. 1) R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
      IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
      IF (K .EQ. KK) R(NRF-1,NCF)=R(NRF-1,NCF)*0.5
      IF (I .EQ. MB) FOE=(YE(3)-YE(1)-(FLOAT(MB)-1.5)*DY)/DY
      IF (I .EQ. MB) R(NRF,NCF)=R(NRF,NCF)*FOE
      IF (I .EQ. MB) R(NRF-1,NCF)=R(NRF-1,NCF)*FOE
  740 CONTINUE
      IF (NCK .EQ. 1 .AND. K .EQ. KK) GO TO 760
      GO TO 750
  760 DO 850 KT=1,KK
      DO 800 JT=1,NXWING
      IF (XAIC(1,III+1,1)-XE(1) .GE. (FLOAT(NXBX(1)-NXBX(I)+KT)-.5)*DX)
     1GO TO 810
      IF (XAIC(NXWING,III+1,1)-XE(1) .LE. (FLOAT(NXBX(1)-NXBX(I)+KT)-.5)
     1*DX) GO TO 820
      IF (XAIC(JT,III+1,1)-XE(1) .GT. (FLOAT(NXBX(1)-NXBX(I)+KT)-.5)*DX)
     1GO TO 830
  800 CONTINUE
  810 NRF=NROW+NXWING+1
      NCF=NCOL+KT
      R(NRF,NCF)=FRT*FOE
      IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
      GO TO 840
  820 NRF=NROW+2*NXWING
      NCF=NCOL+KT
      R(NRF,NCF)=FRT*FOE
      IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*0.5
      GO TO 840
  830 R1=XAIC(JT,III+1,1)-XE(1)-(FLOAT(NXBX(1)-NXBX(I)+KT)-0.5)*DX
      R3=XAIC(JT,III+1,1)-XAIC(JT-1,III+1,1)
      NRF=NROW+NXWING+JT
      NCF=NCOL+KT
      R(NRF,NCF)=(1.0-R1/R3)*FRT*FOE
      R(NRF-1,NCF)=(R1/R3)*FRT*FOE
      IF (I .EQ. 1) R(NRF,NCF)=0.5*R(NRF,NCF)
      IF (I .EQ. 1) R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
      IF (KT .EQ. KK) R(NRF,NCF)=0.5*R(NRF,NCF)
      IF (KT .EQ. KK) R(NRF-1,NCF)=0.5*R(NRF-1 CF)
  840 CONTINUE
  850 CONTINUE
  750 CONTINUE
  600 CONTINUE
      DO 400 I=1,MB
      KK=NXBXCS
      NCK=0
      FRB=1.0
      FRT=1.0
      FOE = 1.0
```

```
      YR=DY*FLOAT(I)-DY
      II=NYCS-1
      DO 410 III=1,II
      IF (0.5*(YAIC(III,2)+YAIC(III+1,2))-YE(1) .GT. YR-.5*DY) GO TO 430
  410 CONTINUE
      III=NYCS
      GO TO 420
  430 CONTINUE
      IF (YR-0.5*DY .LT. 0.5*(YAIC(III,2)+YAIC(III+1,2))-YE(1) .AND.
     1    YR+0.5*DY .GT. 0.5*(YAIC(III,2)+YAIC(III+1,2))-YE(1)) NCK=1
      IF (NCK .EQ. 0) GO TO 420
      FRB=(0.5*(YAIC(III,2)+YAIC(III+1,2))-YE(1)-YR+0.5*DY)/DY
      FRT=1.0-FRB
  420 NROW=NXWING*NYWING+NXCS*(III-1)
      NCOL=NMBXW+(I-1)*NXBXCS
      DO 950 K=1,NXBXCS
      DO 900 J=1,NXCS
      IF (XAIC(1,III,2)-XE(1) .GE. (FLOAT(NBOX-NXBXCS+K)-.5)*DX)
     1GO TO 910
      IF (XAIC(NXCS,III,2)-XE(1) .LE. (FLOAT(NBOX-NXBXCS+K)-.5)*DX)
     1GO TO 920
      IF (XAIC(J,III,2)-XE(1) .GT. (FLOAT(NBOX-NXBXCS+K)-.5)*DX)
     1GO TO 930
  900 CONTINUE
  910 NRF=NROW+1
      NCF=NCOL+K
      R(NRF,NCF)=FRB
      IF (I .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*0.5
      IF (K .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*((FLOAT(NBOX-NXBXCS+1))*DX
     1-XE(4)+XE(1))/DX
      IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)-(FLOAT(NBOX-1))*
     1DX)/DX
      IF (I .EQ. MB) FOE=(YE(3)-YE(1)-(FLOAT(MB)-1.5)*DY)/DY
      IF (I .EQ. MB) R(NRF,NCF)=R(NRF,NCF)*FOE
      GO TO 940
  920 NRF=NROW+NXCS
      NCF=NCOL+K
      R(NRF,NCF)=FRB
      IF (I .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*0.5
      IF (K .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*((FLOAT(NBOX-NXBXCS+1))*DX-
     1XE(4)+XE(1))/DX
      IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)-(FLOAT(NBOX-1))*
     1DX)/DX
      IF (I .EQ. MB) FOE=(YE(3)-YE(1)-(FLOAT(MB)-1.5)*DY)/DY
      IF (I .EQ.MB) R(NRF,NCF)=R(NRF,NCF)*FOE
      GO TO 940
  930 R1=XAIC(J,III,2)-XE(1)-(FLOAT(NBOX-NXBXCS+K)-.5)*DX
      R3=XAIC(J,III,2)-XAIC(J-1,III,2)
      NRF=NROW+J
      NCF=NCOL+K
      R(NRF,NCF)=(1.0-R1/R3)*FRB
      R(NRF-1,NCF)=(R1/R3)*FRB
      IF (I .EQ. 1) R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
      IF (I .EQ. 1) R(NRF,NCF)=0.5*R(NRF,NCF)
      IF (K .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*( FLOAT(NBOX-NXBXCS+K)*DX
     1-XE(4)+XE(1))/DX
      IF (K .EQ. 1) R(NRF-1,NCF)=R(NRF-1,NCF)*( FLOAT(NBOX-NXBXCS+K)*DX
     1-XE(4)+XE(1))/DX
      IF (K .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*( XE(5)-XE(1)- FLOAT(NBOX-1)*
     1DX)/DX
```

```
      IF (K .EQ. KK) R(NRF-1,NCF)=R(NRF-1,NCF)*(XE(5)-XE(1)-
     1FLOAT(NBOX-1)*DX)/DX
      IF (I .EQ. MB) FOE=(YE(3)-YE(1)-(FLOAT(MB)-1.5)*DY)/DY
      IF (I .EQ. MB) R(NRF,NCF)=R(NRF,NCF)*FOE
      IF (I .EQ. MB) R(NRF-1,NCF)=R(NRF-1,NCF)*FOE
  940 CONTINUE
      IF (NCK .EQ. 1 .AND. K .EQ. KK) GO TO 960
      GO TO950
  960 DO 350 KT=1,KK
      DO 300 JT=1,NXCS
      IF (XAIC(1,III+1,2)-XE(1) .GE. (FLOAT(NBOX-NXBXCS+KT)-.5)*DX)
     1GO TO 310
      IF (XAIC(NXCS,III+1,2)-XE(1) .LE. (FLOAT(NBOX-NXBXCS+KT)-.5)*DX)
     1GO TO 320
      IF (XAIC(JT,III+1,2)-XE(1) .GT. (FLOAT(NBOX-NXBXCS+KT)-.5)*DX)
     1GO TO 330
  300 CONTINUE
  310 NRF=NROW+NXCS+1
      NCF=NCOL+KT
      R(NRF,NCF)=FRT*FOE
      IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)- FLOAT(NBOX-1)*
     1DX)/DX
      IF (KT .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*( FLOAT(NBOX-NXBXCS+1)*DX
     1-XE(4)+XE(1))/DX
      GO TO340
  320 NRF=NROW+2*NXCS
      NCF=NCOL+KT
      R(NRF,NCF)=FRT*FOE
      IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)- FLOAT(NBOX-1)*
     1DX)/DX
      IF (KT .EQ. 1) R(NRF,NCF)=R(NRF,NCF)*( FLOAT(NBOX-NXBXCS+1)*DX
     1-XE(4)+XE(1))/DX
      GO TO 340
  330 R1=XAIC(JT,III+1,2)-XE(1)-(FLOAT(NBOX-NXBXCS+KT)*DX-.5*DX)
      R3=XAIC(JT,III+1,2)-XAIC(JT-1,III+1,2)
      NRF=NROW+NXCS+JT
      NCF=NCOL+KT
      R(NRF,NCF)=(1.0-R1/R3)*FRT*FOE
      R(NRF-1,NCF)=(R1/R3)*FRT*FOE
      IF (I .EQ. 1) R(NRF,NCF)=0.5*R(NRF,NCF)
      IF (I .EQ. 1) R(NRF-1,NCF)=0.5*R(NRF-1,NCF)
      IF (KT .EQ. 1) R(NRF,NCF)=R(NRF,NCF)* (FLOAT(NBOX-NXBXCS+1)*DX-
     1XE(4)+XE(1))/DX
      IF (KT .EQ. 1) R(NRF-1,NCF)=R(NRF-1,NCF)*(FLOAT(NBOX-NXBXCS+1)*DX-
     1XE(4)+XE(1))/DX
      IF (KT .EQ. KK) R(NRF,NCF)=R(NRF,NCF)*(XE(5)-XE(1)-FLOAT(NBOX-1)*
     1DX)/DX
      IF (KT .EQ. KK) R(NRF-1,NCF)=R(NRF-1,NCF)*(XE(5)-XE(1)-FLOAT(NBOX-
     11)*DX)/DX
  340 CONTINUE
  350 CONTINUE
  950 CONTINUE
  400 CONTINUE
      RETURN
      END
```

```
CSD2          SD2
      SUBROUTINE SD2 (S,R,C,B,T,TR,TM)
      DIMENSION S(45,45),R(45,45),C(45,45),B(45,45),T(45,45),
     1           TR(45,45),TM(45,45)
      COMMON/C1/KBOX(1000),XE(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C4/NUR(50),NBL(50),KC(50),KL(28),BSL(20),DXE(7),TPI,U
      COMMON/C5/X,Y,DX,DY,EM,FK,EKB,EKR,NP,MP,NB,NBOX,KODE,MODE,NBW,NBT
      COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXCS
      COMMON/C8/NXWING,NYWING,NXCS,NYCS
C *** THIS SUBROUTINE GENERATES THE REAL PART OF THE SUBSTANTIAL
C *** DERIVATIVE MATRIX FOR THE VELOCITY POTENTIAL
      NSUB=NXBX(1)
      MB=NBS
      NM=0
      DO 10 I=1,MB
   10 NM=NM+NXBX(I)+NXBXCS
      DO 20 I=1,NM
      DO 20 J=1,NM
   20  TM(I,J)=0.0
      DO 100 I=1,MB
      IF (NXBX(I) .EQ. 1) GO TO 100
      NXS=NXBX(I)
      CALL BMAT (NXS,NRSB,NCSB,B)
      CALL TMAT (NXS,1,1,1,MSIZE,2,T,R)
      DO 101 MR=1,MSIZE
      DO 101 MC=1,NCSB
      TR(MR,MC)=0.0
      DO 101 MRC=1,MSIZE
  101 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*B(MRC,MC)
      CALL CMAT (NXS,I,2,1,NRSC,NCSC,2,C)
      DO 102 MR=1,NRSC
      DO 102 MC=1,NCSB
      T(MR,MC)=0.0
      DO 102 MRC=1,NCSC
  102 T(MR,MC)=T(MR,MC)+C(MR,MRC)*TR(MRC,MC)
      KROW=0
      DO 140 II=1,I
  140 KROW=KROW+NXBX(I)
      KROW=KROW-NXBX(I)
      DO 180 LR=1,NXS
      LROW=KROW+LR
      DO 180 LC=1,NXS
      LCOL=KROW+LC
  180 TM(LROW,LCOL)=T(LR,LC)
  100 CONTINUE
      IF (NXBXCS .LT. 2) GO TO 300
      DO 200 I=1,MB
      CALL BMAT (NXBXCS,NRSB,NCSB,B)
      CALL TMAT (NXBXCS,1,2,1,MSIZE,3,T,R)
      DO 201 MR=1,MSIZE
      DO 201 MC=1,NCSB
      TR(MR,MC)=0.0
      DO 201 MRC=1,MSIZE
  201 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*B(MRC,MC)
      CALL CMAT (NXBXCS,I,2,2,NRSC,NCSC,3,C)
      DO 202 MR=1,NRSC
      DO 202 MC=1,NCSB
      T(MR,MC)=0.0
      DO 202 MRC=1,NCSC
  202 T(MR,MC)=T(MR,MC)+C(MR,MRC)*TR(MRC,MC)
      KROW=0
```

```
      DO 203 IJ=1,MH
  203 KROW=KROW+NXRX(IJ)
      KROW=KROW+(I-1)*NXBXCS
      DO 208 LR=1,NXRXCS
      NROW=KROW+LR
      KCOL=KROW
      DO 208 LC=1,NXRXCS
      NCOL=KCOL+LC
  208 TM(NROW,NCOL)=T(LR,LC)
  200 CONTINUE
  300 CONTINUE
      RETURN
      END
```

```
C1RAMP
      SUBROUTINE IRAMP (NIF,MROWS,KCOLS,S,R,C,B,T,TR,TI,TM)
      DIMENSION S(45,45),R(45,45),C(45,45),B(45,45),T(45,45),TR(45,45),
     1          TI(45,45),TM(45,45)
      COMMON/C1/KBOX(1000),XF(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C4/MOB(50),NBL(50),KC(50),KL(28),BSL(20),DXE(7),TPI,U
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,PP,NB,NBOX,KODE,MODE,NBW,NBT
      COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXCS
      COMMON/C8/NXWING,NYWING,NXCS,NYCS
      MR=NBS
      KCOLS=NXWING*NYWING+NXCS*NYCS
      KROWS=0
      DO 19 I=1,MR
   19 KROWS=NXBX(I)+NXBXCS+KROWS
C *** ZERO TM MATRIX FOR SPANWISE INTERPOLATION
      DO 20 I=1,KROWS
      DO 20 J=1,KCOLS
   20 TM(I,J)=0.0
C *** SPANWISE INTERPOLATION (WING)
      IF (NYWING .EQ. 0) GO TO 1999
      DO 1000 I=1,NXWING
      CALL BMAT (NYWING,NRSB,NCSB,B)
      CALL IMAT (NYWING,2,1,1,MSIZE,1,T,R)
      DO 1001 MR=1,MSIZE
      DO 1001 MC=1,NCSB
      TR(MR,MC)=0.0
      DO 1001 MRC=1,MSIZE
 1001 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*B(MRC,MC)
      CALL SMAT (MB,NYWING,1,NRSC,NCSC,S)
      DO 1002 MR=1,NRSC
      DO 1002 MC=1,NCSB
      T(MR,MC)=0.0
      DO 1002 MRC=1,NCSC
 1002 T(MR,MC)=T(MR,MC)+S(MR,MRC)*TR(MRC,MC)
      KROW=(I-1)*MB
      DO 1080 LR=1,MB
      LROW=KROW+LR
      KCOL=(I-1)*NYWING
      DO 1080 LC=1,NYWING
      LCOL=KCOL+LC
 1080 TM(LROW,LCOL)=T(LR,LC)
 1000 CONTINUE
 1999 CONTINUE
C *** SPANWISE TRANSFORMATION (CONTROL SURFACE)
      IF (NYCS .EQ. 0) GO TO 2999
      DO 2000 I=1,NXCS
      CALL BMAT (NYCS,NRSB,NCSB,B)
      CALL IMAT (NYCS,2,2,1,MSIZE,1,T,R)
      DO 2001 MR=1,MSIZE
      DO 2001 MC=1,NCSB
      TR(MR,MC)=0.0
      DO 2001 MRC=1,MSIZE
 2001 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*B(MRC,MC)
      CALL SMAT (MB,NYCS,2,NRSC,NCSC,S)
      DO 2002 MR=1,NRSC
      DO 2002 MC=1,NCSB
      T(MR,MC)=0.0
      DO 2002 MRC=1,NCSC
 2002 T(MR,MC)=T(MR,MC)+S(MR,MRC)*TR(MRC,MC)
      KROW=MB*NXWING+(I-1)*MB
      DO 2080 LR=1,MB
```

```
      LROW=KROW+LR
      KCOL=NXWING*NYWING+(I-1)*NYCS
      DO 2080 LC=1,NYCS
      LCOL=KCOL+LC
 2080 TM(LROW,LCOL)=T(LR,LC)
 2000 CONTINUE
 2999 CONTINUE
C *** REARRANGE ROWS AND COLUMNS FOR CHORDWISE TRANSFORMATION
      CALL RMAT (MR,NXWING,MB,NXCS,MSIZE,R)
      DO 2050 MR=1,MSIZE
      DO 2050 MC=1,KCOLS
      TI(MR,MC)=0.0
      DO 2050 MRC=1,KROWS
 2050 TI(MR,MC)=TI(MR,MC)+R(MR,MRC)*TM(MRC,MC)
C *** ZERO TM MATRIX FOR CHORDWISE INTERPOLATION
      MCOLS=MB*(NXWING+NXCS)
      MROWS=0
      DO 10 I=1,MB
   10 MROWS=MROWS+NXBX(I)+NXBXCS
      DO 60 I=1,MROWS
      DO 60 J=1,MCOLS
   60 TM(I,J)=0.0
C *** CHORDWISE INTERPOLATION (WING)
      IF (NXWING .EQ. 0) GO TO 3999
      DO 3000 I=1,MB
      CALL BMAT (NXWING,NRSB,NCSB,B)
      CALL TMAT (NXWING,1,1,I,MSIZE,1,T,R)
      DO 3001 MR=1,MSIZE
      DO 3001 MC=1,NCSB
      TR(MR,MC)=0.0
      DO 3001 MRC=1,MSIZE
 3001 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*B(MRC,MC)
      CALL CMAT (NXWING,I,NIF,1,NRSC,NCSC,1,C)
      DO 3002 MR=1,NRSC
      DO 3002 MC=1,NCSB
      T(MR,MC)=0.0
      DO 3002 MRC=1,NCSC
 3002 T(MR,MC)=T(MR,MC)+C(MR,MRC)*TR(MRC,MC)
      KROW=0
      DO 40 II=1,I
   40 KROW=KROW+NXBX(II)
      KROW=KROW-NXBX(I)
      JJ=NXBX(I)
      DO 3080 LR=1,JJ
      LROW=KROW+LR
      KCOL=(I-1)*NXWING
      DO 3080 LC=1,NXWING
      LCOL=KCOL+LC
 3080 TM(LROW,LCOL)=T(LR,LC)
 3000 CONTINUE
 3999 CONTINUE
C *** CHORDWISE INTERPOLATION (CONTROL SURFACE)
      IF (NXCS .EQ. 0) GO TO 4999
      DO 4000 I=1,MB
      CALL BMAT (NXCS,NRSB,NCSB,B)
      CALL TMAT (NXCS,1,2,I,MSIZE,1,T,R)
      DO 4001 MR=1,MSIZE
      DO 4001 MC=1,NCSB
      TR(MR,MC)=0.0
      DO 4001 MRC=1,MSIZE
 4001 TR(MR,MC)=TR(MR,MC)+T(MR,MRC)*B(MRC,MC)
```

```
      CALL CMAT (NXCS,I,NIF,2,NRSC,NCSC,1,C)
      DO 4002 MR=1,NRSC
      DO 4002 MC=1,NCSB
      T(MR,MC)=0.0
      DO 4002 MRC=1,NCSC
4002  T(MR,MC)=T(MR,MC)+C(MR,MRC)*TR(MRC,MC)
      KROW=LROW+(I-1)*NXBXCS
      DO 4080 LR=1,NXBXCS
      NROW=KROW+LR
      KCOL=MB*NXWING+(I-1)*NXCS
      DO 4080 LC=1,NXCS
      NCOL=KCOL+LC
4080  TM(NROW,NCOL)=T(LR,LC)
4990  CONTINUE
4999  CONTINUE
      DO 5001 MR=1,MROWS
      DO 5001 MC=1,KCOLS
      TR(MR,MC)=0.0
      DO 5001 MRC=1,MCOLS
5001  TR(MR,MC)=TR(MR,MC)+TM(MR,MRC)*TI(MRC,MC)
      CALL RMAT (NXWING,NYWING,NXCS,NYCS,MSIZE,R)
      DO 5050 I=1,MROWS
      DO 5050 J=1,MSIZE
      TI(I,J)=0.0
      DO 5050 K=1,MSIZE
5050  TI(I,J)=TI(I,J)+TR( ,K)*R(K,J)
      DO 5052 I=1,MROWS
      DO 5052 J=1,MSIZE
5052  TR(I,J)=TI(I,J)
      RETURN
      END
```

```
CBSLS          BSLS
      SUBROUTINE BSLS(ARG,N)
      COMMON/C4/MOB(50),NBL(50),KC(50),KL(28),BSL(20),DXE(7),IPI,U
      DO 1  I=1,20
    1 BSL(I) = 0.0
      ASQ = ARG**2
      IF(ASQ.LT.0.01) GO TO 50
      N = MIN1(17.0,(ARG + 10.0))
      F = 2*N + 4
      BSL(N+2) = (4.0*F*(F-1.0)/ASQ-(F-1.0)/F)*0.3E-30
      PF = 0.0
      J = 0
      DO 10 I = J,N
      M = N - I + 1
      F = 2*M + 1
      BSL(M)=(4.0*(F-1.0)/ASQ-1.0/F-1.0/(F-2.0))*BSL(M+1)-BSL(M+2)/F
   10 PF = PF + 2.0*(F-2.0)*BSL(M+1)
      PF = PF + BSL(1)
      F = 0.0
      IF(ABS(PF).GT.1.0)  F = ABS(PF)*1.E-10
      N = N + 2
      DO 30 I = 1,N
      IF(F.GE.ABS(BSL(I))) GO TO 20
      BSL(I) = BSL(I)/PF
      GO TO 30
   20 BSL(I) = 0.0
   30 CONTINUE
      RETURN
   50 BSL(2) = 0.125*ASQ
      BSL(1) = 1.0 - 2.0*BSL(2)
      N = 2
      RETURN
      END
```

```
CCONS          CONS
      BLOCK DATA
      COMPLEX CZERO,VPIC,SS,PHIW,SPHI,PHI,PHITE,DPHI
      COMMON/C1/KBOX(1000),XE(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,LPUNCH,KF
      COMMON/C3/VPIC(2025),SS(2025),PHIW(50),SPHI,CZERO,PHI,PHITE,DPHI
      COMMON/C4/MOB(50),NBL(50),KC(50),KL(28),BSL(20),DXE(7),TPI,U
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,MP,NB,NBOX,KODE,MODE,NBW,NBT
      COMMON/C6/XI,NS,K,J,IFR,TWL,RHO
      COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXCS
      COMMON/C8/NXWING,NYWING,NXCS,NYCS
      DATA KC/1,2,4,7,11,16,22,29,37,46,56,67,79,92,106,121,137,154,172,
     1191,211,232,254,277,301,326,352,379,407,436,466,497,529,562,596,
     2631,667,704,742,781,821,862,904,947,991,1036,1082,1129,1177,1226/,
     3TPI/6.2831853/,CZERO/(0.0,0.0)/
      DATA KL/1,1,1,2,3,1,4,5,6,1,7,8,9,10,1,11,12,13,14,15,1,16,17,18,
     1 19,20,21,1/
      END
```

```
CCAFI        CAFI
      SUBROUTINE CAFI
      COMPLEX CZERO,VPIC,SS,PHIW,SPHI,PHI,PHITE,DPHI
      DIMENSION P(5),W(5)
      COMMON/C1/KBOX(1000),XE(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C2/AS,NMACH,FMACH(6),NFREQ,FREQ(10),NMODE,NSURF,IPUNCH,KF
      COMMON/C3/VPIC(2025),SS(2025),PHIW(50),SPHI,CZERO,PHI,PHITE,DPHI
      COMMON/C4/MOB(50),NBL(50),KC(50),KL(20),BSL(20),DXE(7),TPI,U
      COMMON/C5/X,Y,DX,DY,EM,FK,EKB,EKR,NP,KP,NB,NBOX,KODE,MODE,NBW,NBT
      COMMON/C6/XI,NS,K,J,IFR,TWL,RHO
      DATA P/0.95308992,0.76923465,0.5,0.23076535,0.04691008/
     1    , W/0.11846344,0.23931434,0.28444444,0.23931434,0.11846344/
      PI = TPI/2.0
      IF(EKB.GT.0.0) GO TO 10
      VPIC = (-1.0,0.0)
      GO TO 30
   10 VPIC = CZERO
      DO 20 I = 1,5
      ARG = FKB*P(I)/2.0
      F = -(0.5*ARG/FM)**2
      ZJ = 1.0
      FI = 1.0
      AE = 1.0
      DO 15 K = 1,20
      AE = AE * F/FI**2
      FI = FI + 1.0
      IF(ABS(AE).LE.1.E-5) GO TO 20
   15 ZJ = ZJ + AE
   20 VPIC = VPIC - ZJ*W(I)*CMPLX(COS(ARG),-SIN(ARG))
   30 DO 80 NP = 2,NBOX
      KI = KC(NP)
      KZ = KC(NP+1) - 1
      DO 40 K = KI,KZ
   40 VPIC(K) = CZERO
      NU = NP - 1
      DO 80 I = 1,5
      X = FLOAT(NU) - 0.5 + P(I)
      ARG = EKB*X
      PHI = W(I)*CMPLX(-COS(ARG),SIN(ARG))*2.0/PI
      CALL BSLS(ARG/FM,N)
      K = KC(NP)
      DO 70 MP = 1,NU
      FOX = (FLOAT(MP) - 0.5)/X
      C = SQRT(1.0 - FOX**2)
      AE = 2.0*ATAN(FOX/(1.0 + C))
      S = 2.0*FOX*C
      C = 2.0*C*C - 1.0
      S0 = 0.0
      VIN = BSL*AE
      F = 1.0
      FI = 1.0
      DO 50 I = 1,N
      VIN = BSL(I+1)*S/FI - VIN
      SN = 2.0*S*C - S0
      S0 = S
      S = SN
      F = -F
   50 FI = FI + 1.0
      DPHI = PHI*VIN*F
      VPIC(K) = VPIC(K) + DPHI
      VPIC(K+1) = VPIC(K+1) - DPHI
```

```
      IF(MP.EQ.1) VPIC(K) = VPIC(K) + DPHI
   70 K = K + 1
   80 VPIC(K) = VPIC(K) +PI*DSL*PHI/2.0
      RETURN
      END
```

```
CPHIB         PHIB
      SUBROUTINE PHIB
      COMPLEX CZERO,VPIC,SS,PHIW,SPHI,PHI,PHITE,DPHI
      COMMON/C3/VPIC(2025),SS(2025),PHIW(50),SPHI,CZERO,PHI,PHITE,DPHI
      COMMON/C4/MOB(50),NBL(50),KC(50),KL(28),BSL(20),DXE(7),IPI,U
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,MP,NB,NBOX,KODE,MODE,NBW,NBT
      COMMON/C6/XL,NS,K,J,IFR,TWL,RHO
      DO 20 I=2,NP
      NU=NP-I+1
      JL=MAX0(1,MP-I+1)
      JR=MIN0(MOB(NU),MP+I-1)
      NJ=NBL(NU)+JL
      DO 20 J=JL,JR
      K=KC(I)+IABS(MP-J)
      DPHI=VPIC(K)
      IF (J.GT.I-MP+1.OR.J.EQ.1) GO TO 10
      K=KC(I)+MP+J-2
      DPHI=DPHI+VPIC(K)
   10 SPHI=SPHI+DPHI*SS(NJ)
   20 NJ=NJ+1
      RETURN
      END
```

```
CARLF          ARLE
      FUNCTION ARLF(TOB)
      COMMON/C1/KBOX(1000),XF(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C5/X,      DY,EM,EK,EKB,EKR,NP,PP,NB,NBOX,KODE,MODE,NBW,NBT
      COMMON/C6/XL,DS,K,J,IFR,TWL,RHO
      IF(X-0.5*DX.GE.X1-X2) GO TO 10
      IF (TOB .EQ. 0.0 .OR. TOB .GT. 1.0E+10) GO TO 20
      YT = (Y-Y1)/DY+0.5-(X/DX-0.5)/TOB
      XR = YT*TOB
      YB = AMAX1(0.0,AMIN1(1.0,YT-1.0/TOB))
      YT = AMIN1(1.0,AMAX1(0.0,YT))
      XL = AMAX1(0.0,AMIN1(1.0,XR-TOB))
      XR = AMIN1(1.0,AMAX1(0.0,XR))
      ARLE = AMAX1(0.5*(YT*(XR+XL)+YB*(XR-XL)),0.0)
      IF(MP.EQ.1) ARLF = 2.0*ARLE
      RETURN
   10 ARLE = AMIN1(1.0,AMAX1(0.0,(Y-Y2)/DY+0.5))
      RETURN
   20 ARLF = 0.0
      RETURN
      END
```

```
CCMAT
      SUBROUTINE CMAT (NAICPX,IY,NIF,NS,NRS,NCS,NE,C)
      DIMENSION C(45,45)
      COMMON/C1/KBOX(1000),XF(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,PP,NB,NBOX,KODE,MODE,NBW,NBT
      COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXCS
      COMMON/C8/NXWING,NYWING,NXCS,NYCS
C *** FOR CHORDWISE INTERPOLATION
C *** NPTS = NUMBER OF CHORDWISE MACH BOXES
C *** NAICPX = NUMBER OF CHORDWISE AIC CONTROL POINTS
C *** IY = SPAN NUMBER
C *** NIF = CONTROL FOR DIFFERENTIATION  (1=NO DERIVATIVE AND 2=D()/DX)
C *** NS = SURFACE (1=WING AND 2=TAIL)
      IF (NAICPX .GT. 3) GO TO 3
      NRS=NXBX(IY)
      IF (NS .EQ. 2) NRS=NXBXCS
      NCS=NAICPX
      DO 1 I=1,NRS
      DO 1 J=1,NCS
    1 C(I,J)=0.0
      GO TO 100
    3 NRS=NXBX(IY)
      IF (NS .EQ. 2) NRS=NXBXCS
      NCS=3*(NAICPX-2)
      DO 4 I=1,NRS
      DO 4 J=1,NCS
    4 C(I,J)=0.0
  100 IF (NCS .GT. 6) GO TO 500
      IF (NCS .EQ. 6) GO TO 400
      GO TO (200,200,300),NCS
C *** TWO CHORDWISE AIC CONTROL POINTS
  200 DO 210 I=1,NRS
      C(I,1)=1.0
      C(I,2)=XBOX(I,IY,NS,NE)
      IF (NIF .EQ. 2) C(I,1)=0.0
      IF (NIF .EQ. 2) C(I,2)=1.0
  210 CONTINUE
      RETURN
C *** THREE CHORDWISE AIC CONTROL POINTS
  300 DO 310 I=1,NRS
      C(I,1)=1.0
      C(I,2)=XBOX(I,IY,NS,NE)
      C(I,3)=XBOX(I,IY,NS,NE)**2
      IF (NIF .EQ. 2) C(I,1)=0.0
      IF (NIF .EQ. 2) C(I,2)=1.0
      IF (NIF .EQ. 2) C(I,3)=2.0*XBOX(I,IY,NS,NE)
  310 CONTINUE
      RETURN
C *** FOUR CHORDWISE AIC CONTROL POINTS
  400 DO 410 I=1,NRS
      NX=NAICPX-1
      DO 406 J=1,NX
      IF (0.5*(XINT(J,IY,NS,NE)+XINT(J+1,IY,NS,NE)) .GT. XBOX(I,IY,NS,NE
     1)) GO TO 407
  406 CONTINUE
      NX=NAICPX
      GO TO 408
  407 NX=J
  408 KC=1
      IF (NX .GT. 2) KC=4
      C(I,KC)=1.0
```

```
      C(I,KC+1)=XBOX(I,IY,NS,NE)
      C(I,KC+2)=C(I,KC+1)**2
      IF (NIF .EQ. 2) C(I,KC)=0.0
      IF (NIF .EQ. 2) C(I,KC+1)=1.0
      IF (NIF .EQ. 2) C(I,KC+2)=2.0*XBOX(I,IY,NS,NE)
  410 CONTINUE
      RETURN
C *** .GT. FOUR AIC CONTROL POINTS
  500 DO 510 I=1,NRS
      NX=NAICPX-1
      DO 506 J=1,NX
      IF (0.5*(XINT(J,IY,NS,NE)+XINT(J+1,IY,NS,NE)) .GT. XBOX(I,IY,NS,NE
     1)) GO TO 507
  506 CONTINUE
      NX=NAICPX
      GO TO 508
  507 NX=J
  508 IF (NX .LT. 3) GO TO 550
      IF (NX .GT. NAICPX-2) GO TO 580
      KC=(NX-2)*3+1
      C(I,KC)=1.0
      C(I,KC+1)=XBOX(I,IY,NS,NE)
      C(I,KC+2)=C(I,KC+1)**2
      IF (NIF .EQ. 2) C(I,KC+1)=1.0
      IF (NIF .EQ. 2) C(I,KC+2)=XBOX(I,IY,NS,NE)
      IF (NIF .EQ. 2) C(I,KC)=0.0
      GO TO 510
  550 C(I,1)=1.0
      C(I,2)=XBOX(I,IY,NS,NE)
      C(I,3)=C(I,2)**2
      IF (NIF .EQ. 2) C(I,1)=0.0
      IF (NIF .EQ. 2) C(I,2)=1.0
      IF (NIF .EQ. 2) C(I,3)=XBOX(I,IY,NS,NE)
      GO TO 510
  580 C(I,NCS-2)=1.0
      C(I,NCS-1)=XBOX(I,IY,NS,NE)
      C(I,NCS)=C(I,NCS-1)**2
      IF (NIF .EQ. 2) C(I,NCS-2)=0.0
      IF (NIF .EQ. 2) C(I,NCS-1)=1.0
      IF (NIF .EQ. 2) C(I,NCS)=XBOX(I,IY,NS,NE)
  510 CONTINUE
      RETURN
      END
```

CRMAT

```
      SUBROUTINE RMAT (NXWING,NYWING,NXCS,NYCS,MSIZE,R)
      DIMENSION R(45,45)
      MSIZE=NXWING*NYWING+NXCS*NYCS
      DO 100 I=1,MSIZE
      DO 100 J=1,MSIZE
  100 R(I,J)=0.0
      IF (NXWING .EQ. 0) GO TO 250
      K=1
      KK=1
      II=NYWING*NXWING
      DO 200 I=1,II
      R(I,K)=1.0
      K=K+NXWING
      IF (K .GT. II) KK=KK+1
      IF (K .GT. II) K=KK
  200 CONTINUE
  250 CONTINUE
      IF (NXCS .EQ. 0) GO TO 350
      II=NXCS*NYWING
      K=NXWING*NYWING+1
      KK=NXWING*NYWING+1
      DO 300 I=1,II
      IK=I+NXWING*NYWING
      R(IK,K)=1.0
      K=K+NXCS
      IF (K .GT. MSIZE) KK=KK+1
      IF (K .GT. MSIZE) K=KK
  300 CONTINUE
  350 CONTINUE
      RETURN
      END
```

```
CXINT
      FUNCTION XINT(NX,NY,NS,NE)
      COMMON/C1/KBOX(1000),XF(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C4/MOB(50),NBL(50),KC(50),KL(28),BSL(20),DXF(7),IPI,U
      COMMON/C5/X,Y,DX,DY,FM,EK,EKB,EKR,NP,MP,NB,NBOX,KODE,MODE,NBW,NBT
      COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXCS
      COMMON/C8/NXWING,NYWING,NXCS,NYCS
      IF (NE .GT. 1) GO TO 400
      IF (NS .EQ. 1) GO TO 200
      XINT=XAIC(NX,1,NS)
      RETURN
  200 IF (FLOAT(NY)*DY-DY .GE. YE(2)) GO TO 300
      XINT=XAIC(NX,1,NS)
      RETURN
  300 IF (YAIC(1,1) .LE. YE(2))
     1SLOPE=(YAIC(NYWING,1)-YE(2))/(XAIC(NX,NYWING,1)-XAIC(NX,1,1))
      IF (YAIC(1,1) .GT. YE(2))
     1SLOPE=(YAIC(NYWING,1)-YAIC(1,1))/(XAIC(NX,NYWING,1)-XAIC(NX,1,1))
      IF (YAIC(1,1) .LE. YE(2))
     1XINT=(DY*FLOAT(NY)-DY-YE(2)+YE(1))/SLOPE + XAIC(NX,1,1)
      IF (YAIC(1,1) .GT. YE(2))
     1XINT=(DY*FLOAT(NY)-DY-YAIC(1,1)+YE(1))/SLOPE + XAIC(NX,1,1)
      RETURN
  400 XINT=DX*(FLOAT(NX)-0.5)
      RETURN
      END
```

```
CXBOX
      FUNCTION XBOX(NX,NY,NS,NE)
      COMMON/C1/KBOX(1000),XE(5),YE(3),X1,X2,X3,X4,Y1,Y2,BETA,NBS
      COMMON/C5/X,Y,DX,DY,EM,EK,EKB,EKR,NP,PP,NB,NBOX,KODE,MODE,NBW,NBT
      COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXCS
      IF (NE .GT. 1) GO TO 300
      IF (NS .EQ. 2) GO TO 200
      XBOX=DX*(FLOAT(NXBX(1))-FLOAT(NXBX(NY)))+DX*FLOAT(NX)-0.5*DX
      RETURN
  200 XBOX=XE(4)+DX*(FLOAT(NX)-0.5)
      RETURN
  300 XBOX=DX*(FLOAT(NX)-0.5)
      RETURN
      END
```

```
CYBOX
      FUNCTION YBOX(NY)
      COMMON/C5/X,Y,DX,DY,FM,EK,EKB,EKR,NP,MP,NB,NBOX,KODE,MODE,NBW,NBT
      YBOX=DY*(FLOAT(NY)-1.0)
      RETURN
      END
```

```
C BMAT
      SUBROUTINE BMAT (NPTS,IROWS,ICOLS,B)
      DIMENSION B(45,45)
C *** B = B(IROWS,ICOLS)  MATRIX
C *** NPTS = NUMBER OF AIC STATIONS ALONG STRIP (CHORDWISE OR SPANWISE)
      ICOLS=NPTS
      IF (NPTS .GT. 3) GO TO 200
      IROWS=NPTS
      DO 50 I=1,IROWS
      DO 50 J=1,ICOLS
      B(I,J)=0.0
      IF (I .EQ. J) B(I,J)=1.0
   50 CONTINUE
      RETURN
  200 IROWS=6+(NPTS-4)*3
      DO 300 I=1,IROWS
      DO 300 J=1,ICOLS
  300 B(I,J)=0.0
      B(1,1)=1.0
      B(2,2)=1.0
      B(IROWS,ICOLS)=1.0
      B(IROWS-1,ICOLS-1)=1.0
      IF (NPTS .EQ. 4) GO TO 400
      K=NPTS-4
      DO 350 I=1,K
      NR=2+3*I
      NC=2+I
  350 B(NR,NC)=1.0
  400 RETURN
      END
```

```
CSMAT
      SUBROUTINE SMAT (NIY,NAICPY,NS,NRS,NCS,S)
      DIMENSION S(45,45)
      COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXCS
      COMMON/C8/NXWING,NYWING,NXCS,NYCS
C *** NAICPY = NUMBER OF SPANWISE AIC CONTROL POINTS
C *** NS = SURFACE (1=WING AND 2=TAIL)
C *** NRS = NUMBER OF ROWS IN S-MATRIX
C *** NCS = NUMBER OF COLUMNS IN S-MATRIX
C     COMMON
      IF (NAICPY .GT. 3) GO TO 8
      NRS=NIY
      NCS=NAICPY
      DO 6 I=1,NRS
      DO 6 J=1,NCS
    6 S(I,J)=0.0
      GO TO 100
    8 NRS=NIY
      NCS=3*(NAICPY-2)
      DO 9 I=1,NRS
      DO 9 J=1,NCS
    9 S(I,J)=0.0
  100 IF (NCS .GT. 6) GO TO 500
      IF (NCS .EQ. 6) GO TO 400
      GO TO (200,200,300),NCS
C *** TWO AIC POINTS
  200 DO 260 I=1,NIY
      S(I,1)=1.0
      S(I,2)=YBOX(I)
  260 CONTINUE
      RETURN
C *** THREE AIC POINTS
  300 DO 360 I=1,NIY
      S(I,1)=1.0
      S(I,2)=YBOX(I)
      S(I,3)=S(I,2)**2
  360 CONTINUE
      RETURN
C *** FOUR AIC POINTS
  400 DO 490 I=1,NIY
      IC=4
      IF (YBOX(I) .LT. 0.5*(YAIC(2,NS)+YAIC(3,NS))) IC=1
      S(I,IC)=1.0
      S(I,IC+1)=YBOX(I)
      S(I,IC+2)=S(I,IC+1)**2
  490 CONTINUE
      RETURN
C *** .GT. FOUR AIC POINTS
  500 DO 520 I=1,NIY
      NI=NAICPY-2
      DO 525 J=1,NI
      IF(0.5*(YAIC(J,NS)+YAIC(J+1,NS)) .GT. YBOX(I)) GO TO 523
  525 CONTINUE
      IC=3*NAICPY-8
      GO TO 524
  523 IC=(J-2)*3+4
      IF (J .LT. 3) IC=1
  524 S(I,IC)=1.0
      S(I,IC+1)=YBOX(I)
      S(I,IC+2)=S(I,IC+1)**2
  520 CONTINUE
```

```
RETURN
END
```

```
CIMAT  IMAT
      SUBROUTINE IMAT (NPTS,ND,NS,IY,MSIZE,NE,T,R)
      DIMENSION T(45,45),R(45,45)
      COMMON/C7/XAIC(10,10,2),YAIC(10,2),NXBX(40),NYBX(40),NXBXCS
      COMMON/C8/NXWING,NYWING,NXCS,NYCS
C *** GENERATES (T)**(-1) MATRIX
C *** NPTS = NUMBER OF AIC POINTS ALONG STRIP IN ND DIRECTION
C *** MSIZE = ORDER OF  T  MATRIX
C *** NS = SURFACE  (1=WING AND 2=CONTROL SURFACE)
C *** ND = INTERPOLATION DIRECTION  (1=CHORDWISE AND 2=SPANWISE)
      IF (NPTS .LT. 4) MSIZE=NPTS
      IF (NPTS .GT. 3) MSIZE=3*NPTS-6
      DO 1 J=1,MSIZE
      DO 1 K=1,MSIZE
    1 T(J,K)=0.0
      IF (NPTS .GT. 4) GO TO 5000
      GO TO (2000,2000,3000,4000), NPTS
C *** NPTS=2  (TWO POINTS ALONG STRIP)
 2000 T(1,1)=1.0
      T(2,1)=1.0
      IF (ND .EQ. 1) T(1,2)=XINT(1,IY,NS,NE)
      IF (ND .EQ. 1) T(2,2)=XINT(2,IY,NS,NE)
      IF (ND .EQ. 2) T(1,2)=YAIC(1,NS)
      IF (ND .EQ. 2) T(2,2)=YAIC(2,NS)
      GO TO 6000
C *** NPTS=3  (THREE POINTS ALONG STRIP)
 3000 T(1,1)=1.0
      T(2,1)=1.0
      T(3,1)=1.0
      IF (ND .EQ. 2) GO TO 3010
C *** NPTS=3  CHORDWISE DIRECTION
      T(1,2)=XINT(1,IY,NS,NE)
      T(1,3)=T(1,2)**2
      T(2,2)=XINT(2,IY,NS,NE)
      T(2,3)=T(2,2)**2
      T(3,2)=XINT(3,IY,NS,NE)
      T(3,3)=T(3,2)**2
      GO TO 6000
C *** NPTS=3  SPANWISE DIRECTION
 3010 T(1,2)=YAIC(1,NS)
      T(1,3)=T(1,2)**2
      T(2,2)=YAIC(2,NS)
      T(2,3)=T(2,2)**2
      T(3,2)=YAIC(3,NS)
      T(3,3)=T(3,2)**2
      GO TO 6000
C *** NPTS=4  (FOUR POINTS ALONG STRIP)
 4000 T(1,1)=1.0
      T(2,1)=1.0
      T(3,1)=1.0
      T(4,2)=1.0
      T(5,4)=1.0
      T(6,4)=1.0
      T(3,4)=-1.0
      T(4,5)=-1.0
      IF (ND .EQ. 2) GO TO 4010
C *** NPTS=4  CHORDWISE DIRECTION
      T(1,2)=XINT(1,IY,NS,NE)
      T(1,3)=T(1,2)**2
      T(2,2)=XINT(2,IY,NS,NE)
```

```
      T(2,3)=T(2,2)**2
      T(3,2)=0.5*(XINT(2,IY,NS,NE)+XINT(3,IY,NS,NE))
      T(3,3)=T(3,2)**2
      T(3,5)=-T(3,2)
      T(3,6)=-T(3,3)
      T(4,3)=2.0*T(3,2)
      T(4,6)=-T(4,3)
      T(5,5)=XINT(3,IY,NS,NE)
      T(5,6)=T(5,5)**2
      T(6,5)=XINT(4,IY,NS,NE)
      T(6,6)=T(6,5)**2
      GO TO 6000
C *** NPTS=4  SPANWISE DIRECTION
 4010 T(1,2)=YAIC(1,NS)
      T(1,3)=T(1,2)**2
      T(2,2)=YAIC(2,NS)
      T(2,3)=T(2,2)**2
      T(3,2)=0.5*(YAIC(2,NS)+YAIC(3,NS))
      T(3,3)=T(3,2)**2
      T(3,5)=-T(3,2)
      T(3,6)=-T(3,3)
      T(4,3)=2.0*T(3,2)
      T(4,6)=-T(4.3)
      T(5,5)=YAIC(3,NS)
      T(5,6)=T(5,5)**2
      T(6,5)=YAIC(4,NS)
      T(6,6)=T(6,5)**2
      GO TO 6000
C *** NPTS .GT. 4
 5000 IF (ND .EQ. 2) GO TO 5500
C *** NPTS .GT. 4  (CHORDWISE DIRECTION)
      T(1,1)=1.0
      T(1,2)=XINT(1,IY,NS,NE)
      T(1,3)=T(1,2)**2
      T(2,1)=1.0
      T(2,2)=XINT(2,IY,NS,NE)
      T(2,3)=T(2,2)**2
      T(MSIZE,MSIZE-2)=1.0
      T(MSIZE,MSIZE-1)=XINT(NPTS,IY,NS,NE)
      T(MSIZE,MSIZE)=T(MSIZE,MSIZE-1)**2
      T(MSIZE-1,MSIZE-2)=1.0
      T(MSIZE-1,MSIZE-1)=XINT(NPTS-1,IY,NS   E)
      T(MSIZE-1,MSIZE)=T(MSIZE-1,MSIZE-1)*
      NI=NPTS-4
      DO 5010 N=1,NI
      NR=2+3*N
      NC=3*N+1
      NP=N+2
      T(NR,NC)=1.0
      T(NR,NC+1)=XINT(NP,IY,NS,NE)
 5010 T(NR,NC+2)=T(NR,NC+1)**2
      NI=NPTS-3
      DO 5020 N=1,NI
      NR=3*N
      NC=3*N-2
      T(NR,NC)=1.0
      T(NR+1,NC+1)=1.0
      T(NR,NC+3)=-1.0
      T(NR+1,NC+4)=-1.0
      T(NR,NC+1)=0.5*(XINT(N+1,IY,NS,NE)+XINT(N+2,IY,NS,NE))
      T(NR,NC+2)=T(NR.NC+1)**2
```

```
      T(NR,NC+4)=-T(NR,NC+1)
      T(NR,NC+5)=-T(NR,NC+2)
      T(NR+1,NC+2)=2.0*T(NR,NC+1)
 5020 T(NR+1,NC+5)=-T(NR+1,NC+2)
      GO TO 6000
C *** NPTS .GT. 4  (SPANWISE DIRECTION)
 5500 T(1,1)=1.0
      T(1,2)=YAIC(1,NS)
      T(1,3)=T(1,2)**2
      T(2,1)=1.0
      T(2,2)=YAIC(2,NS)
      T(2,3)=T(2,2)**2
      T(MSIZE,MSIZE-2)=1.0
      T(MSIZE,MSIZE-1)=YAIC(NPTS,NS)
      T(MSIZE,MSIZE)=T(MSIZE,MSIZE-1)**2
      T(MSIZE-1,MSIZE-2)=1.0
      T(MSIZE-1,MSIZE-1)=YAIC(NPTS-1,NS)
      T(MSIZE-1,MSIZE)=T(MSIZE-1,MSIZE-1)**2
      NI=NPTS-4
      DO 5510 N=1,NI
      NR=2+3*N
      NC=3*N+1
      NP=N+2
      T(NR,NC)=1.0
      T(NR,NC+1)=YAIC(NP,NS)
 5510 T(NR,NC+2)=T(NR,NC+1)**2
      NI=NPTS-3
      DO 5520 N=1,NI
      NR=3*N
      NC=3*N-2
      T(NR,NC)=1.0
      T(NR+1,NC+1)=1.0
      T(NR,NC+3)=-1.0
      T(NR+1,NC+4)=-1.0
      T(NR,NC+1)=0.5*(YAIC(N+1,NS)+YAIC(N+2,NS))
      T(NR,NC+2)=T(NR,NC+1)**2
      T(NR,NC+4)=-T(NR,NC+1)
      T(NR,NC+5)=-T(NR,NC+2)
      T(NR+1,NC+2)=2.0*T(NR,NC+1)
 5520 T(NR+1,NC+5)=-T(NR+1,NC+2)
C *** INVERT  T  MATRIX
 6000 CONTINUE
      CALL MINV (MSIZE,T,R)
      RETURN
      END
```

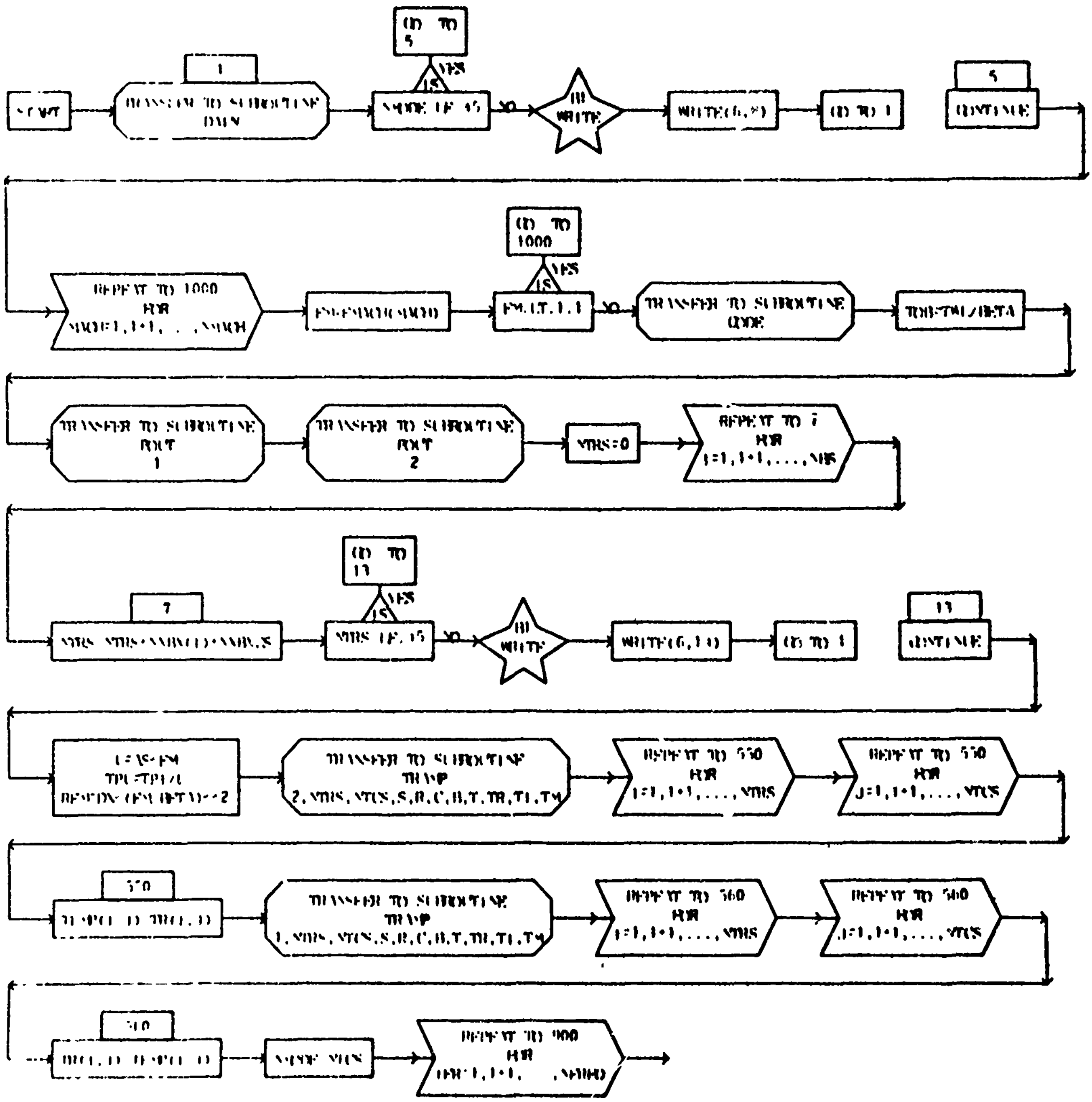
```
CMINV     MINV
      SUBROUTINE MINV (NM,A,U)
      DIMENSION A(45,45),U(45,45)
      DO 9001 I=1,NM
      DO 9001 J=1,NM
      U(I,J)=0.0
      IF (I.EQ.J) U(I,J)=1.0
 9001 CONTINUE
      EPS=0.0000001
      DO 9015 I=1,NM
      K=I
      IF (I-NM) 9021,9007,9021
 9021 IF (A(I,I)-EPS) 9005,9006,9007
 9005 IF (-A(I,I)-EPS) 9006,9006,9007
 9006 K=K+1
      DO 9023 J=1,NM
      U(I,J)=U(I,J)+U(K,J)
 9023 A(I,J)=A(I,J)+A(K,J)
      GO TO 9021
 9007 DIV=A(I,I)
      DO 9009 J=1,NM
      U(I,J)=U(I,J)/DIV
 9009 A(I,J)=A(I,J)/DIV
      DO 9015 MM=1,NM
      DELT=A(MM,I)
      IF (ABS(DELT)-EPS) 9015,9015,9016
 9016 IF (MM-I) 9010,9015,9010
 9010 DO 9011 J=1,NM
      U(MM,J)=U(MM,J)-U(I,J)*DELT
 9011 A(MM,J)=A(MM,J)-A(I,J)*DELT
 9015 CONTINUE
      DO 9033 I=1,NM
      DO 9033 J=1,NM
 9033 A(I,J)=U(I,J)
      RETURN
      END
```

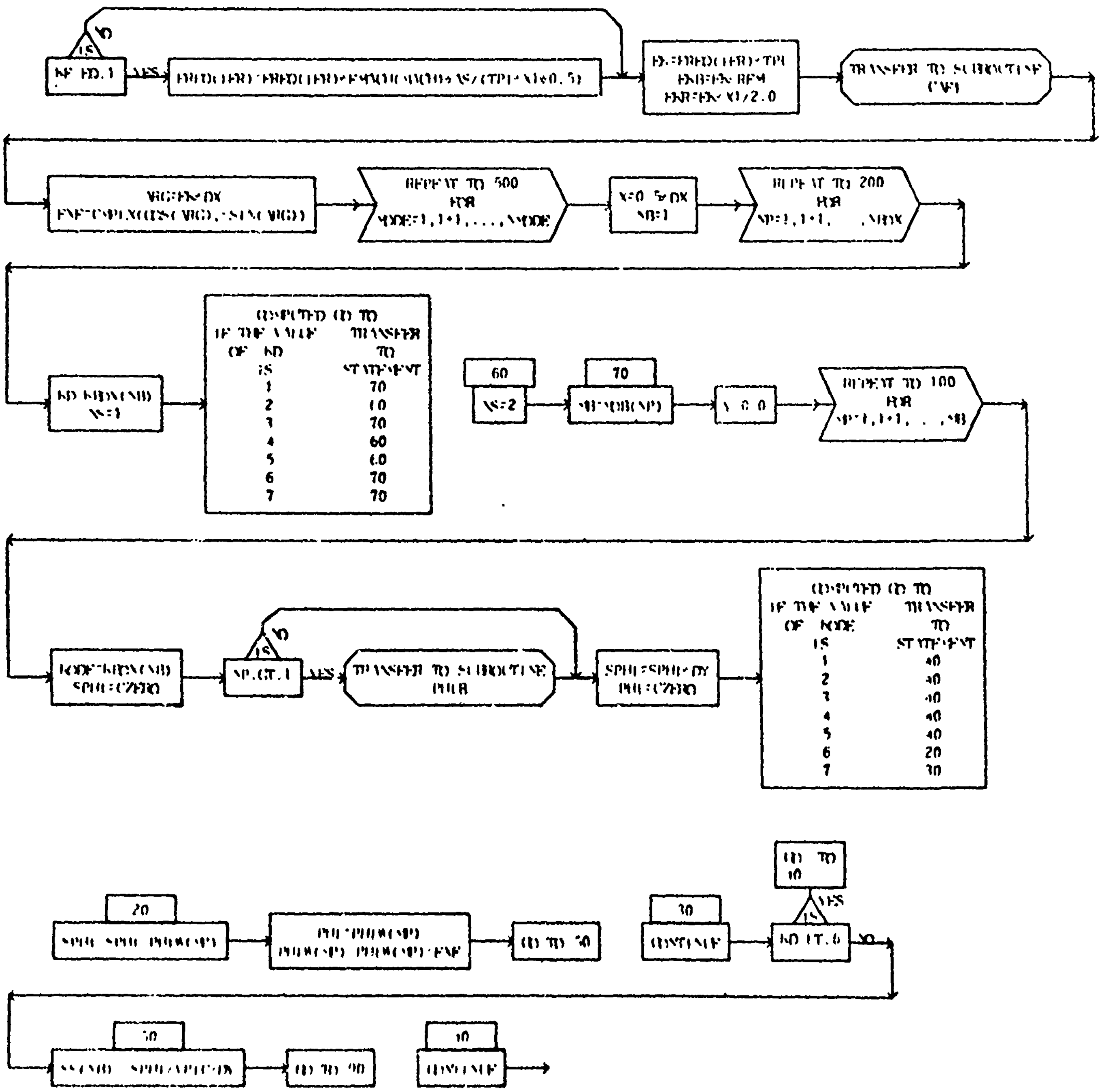
PART VI - SECTION B5.0

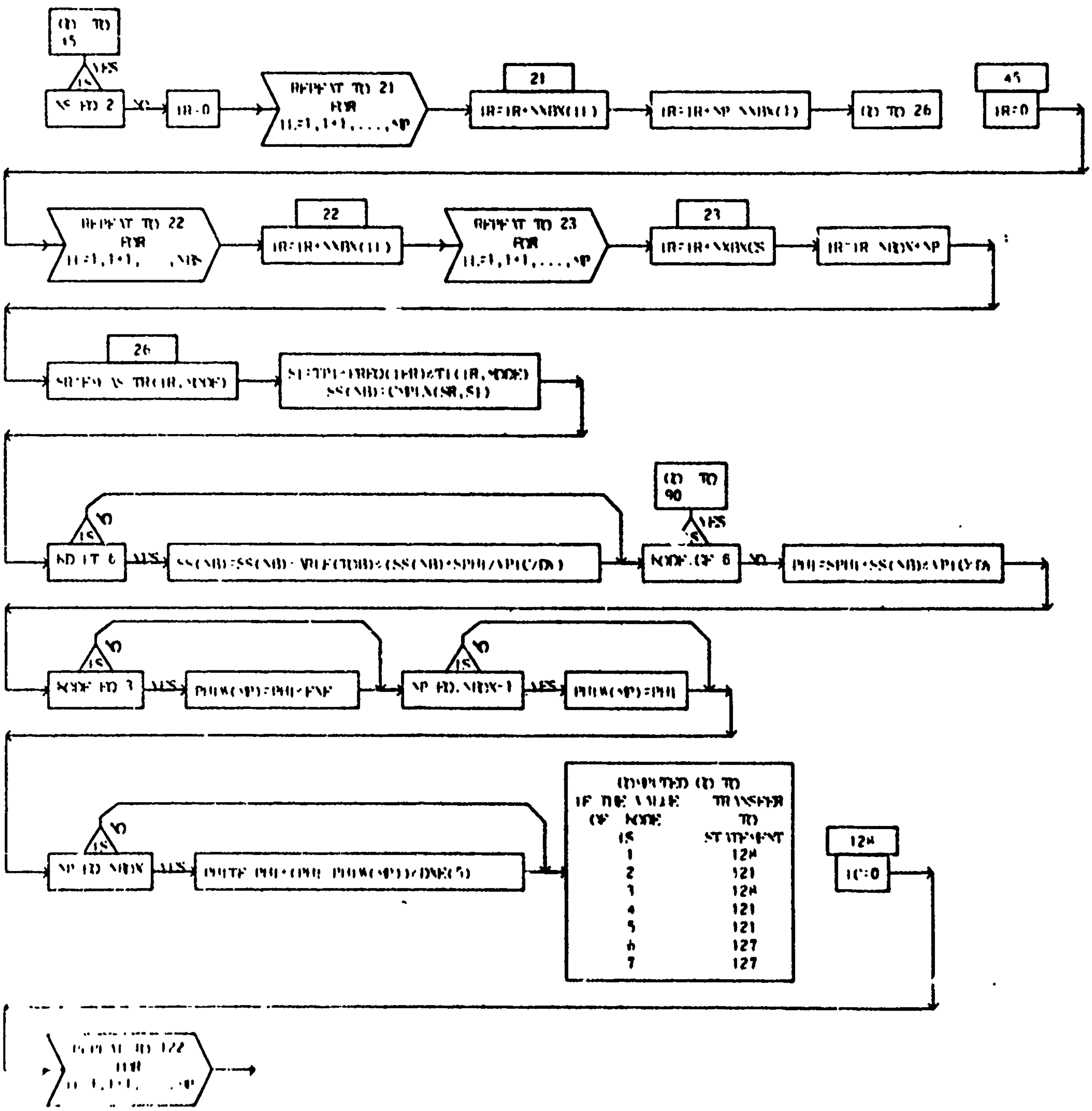
FLOW CHARTS FOR SUPERSONIC ATC
COMPUTER PROGRAM

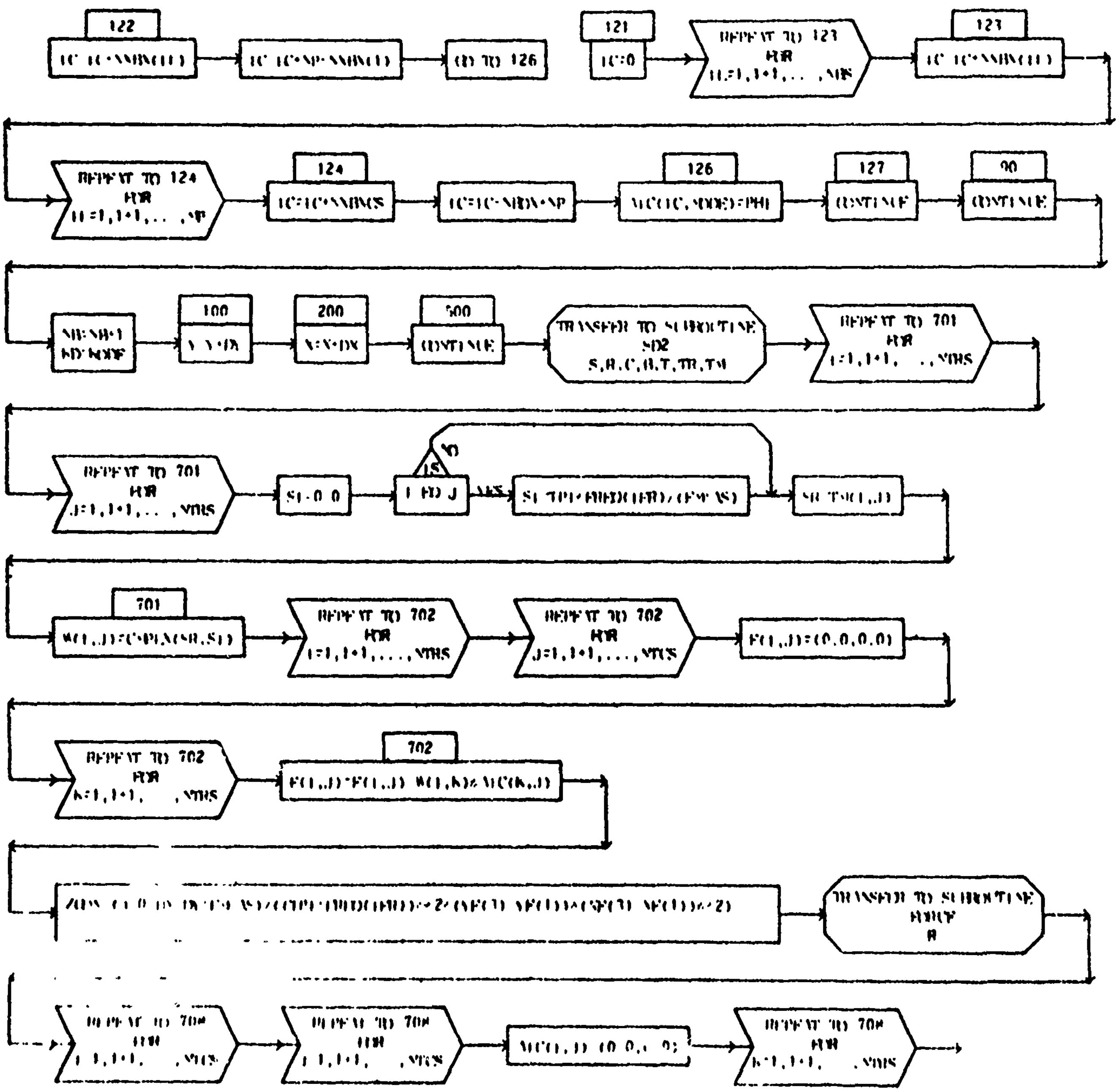
D I M E N S I O N E D   V A R I A B L E S

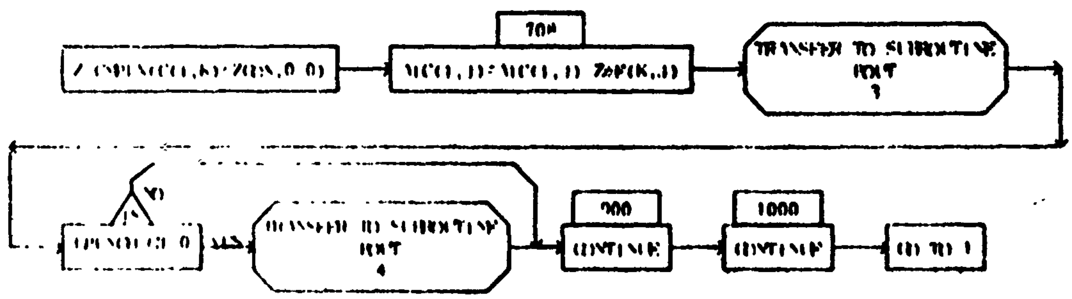
SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
F	45,45	W	45,45	S	45,45	R	45,45	TEMP	45,45
B	45,45	C	45,45	T	45,45	TM	45,45	TI	45,45
TR	45,45								

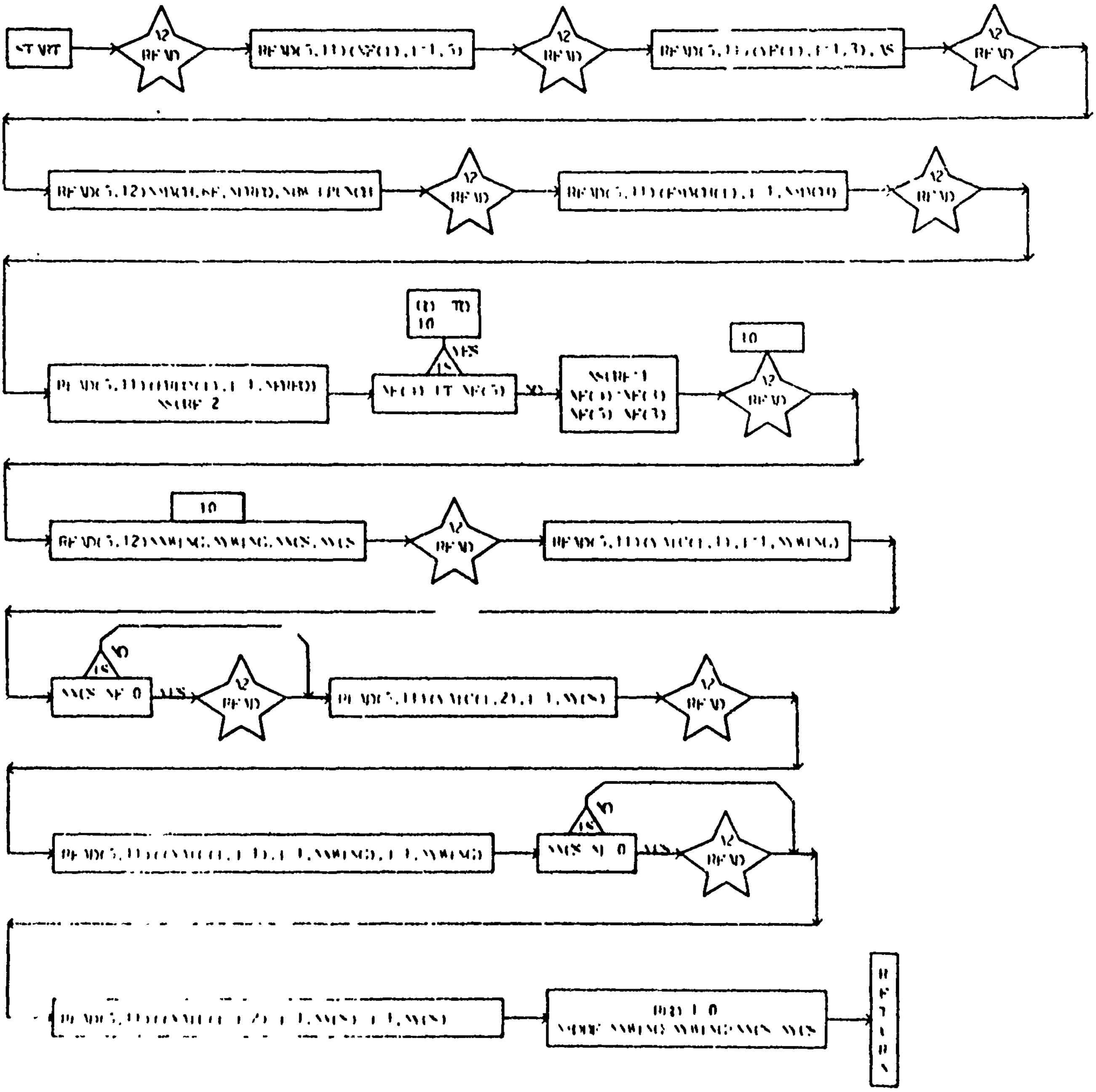

START
GO TO 5
YES
IS
NO
WRITE
GO TO 1
5
REPEAT TO 1000
FOR
GO TO 1000
TRANSFER TO SUBROUTINE
CODE
TRANSFER TO SUBROUTINE
ROOT
1
TRANSFER TO SUBROUTINE
ROOT
2
NTRS=0
REPEAT TO 7
FOR
GO TO
13
7
13
TRANSFER TO SUBROUTINE
TRAMP
REPEAT TO 550
FOR
REPEAT TO 560
FOR
REPEAT TO 900
FOR

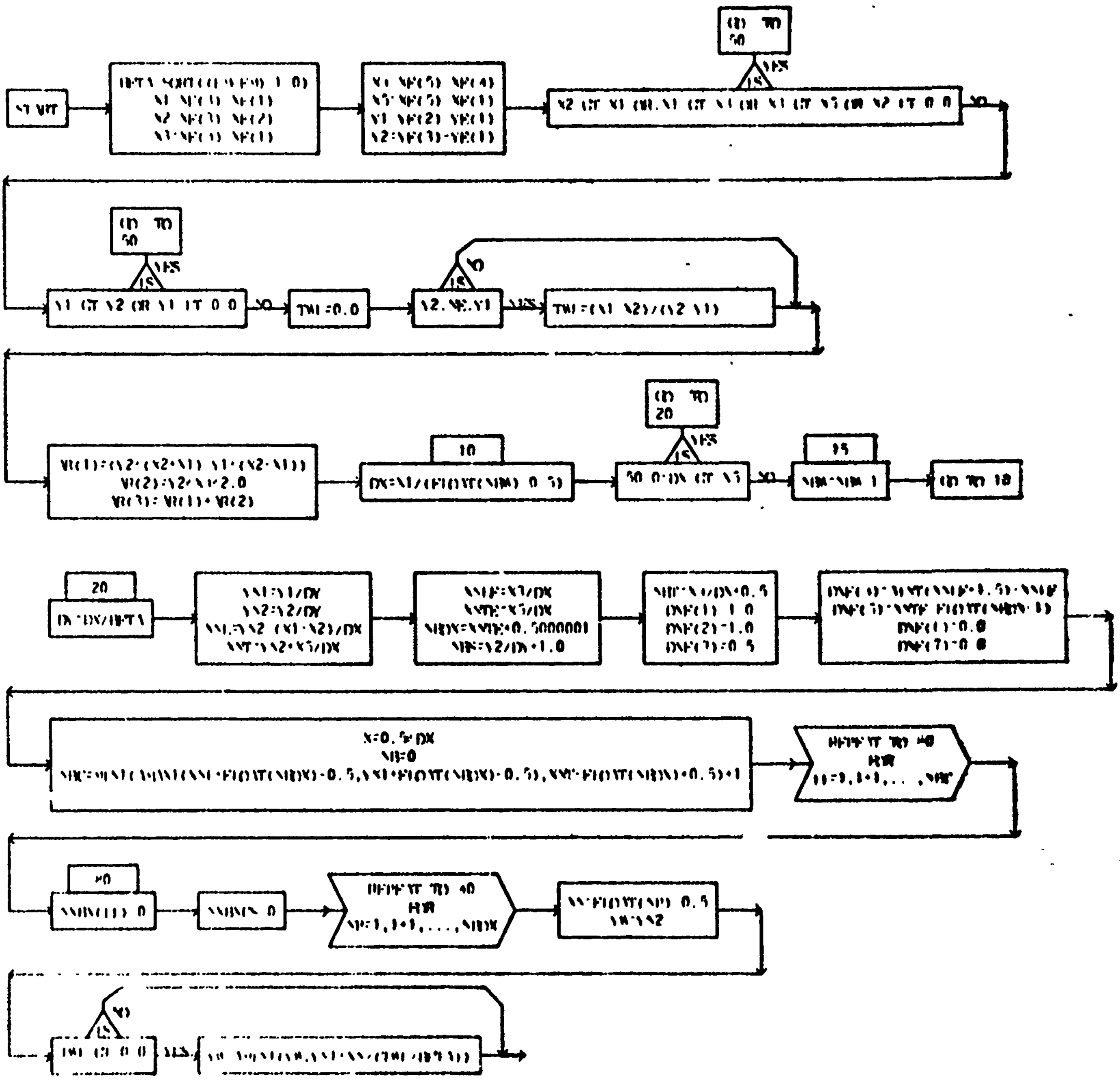

IS
NO
YES
TRANSFER TO SUBROUTINE
REPEAT TO 500
FOR
REPEAT TO 200
FOR
COMPUTED GO TO
IF THE VALUE
TRANSFER
TO
STATEMENT
1 70
2 60
3 70
4 60
5 60
6 70
7 70
60
70
REPEAT TO 100
FOR
SPHI=CZERO
PHI=CZERO
COMPUTED GO TO
IF THE VALUE
OF NODE
IS
TRANSFER
TO
STATEMENT
1 40
2 40
3 40
4 40
5 40
6 20
7 30
20
GO TO 50
30
CONTINUE
GO TO
40
YES
NO
50
GO TO 90
40
CONTINUE

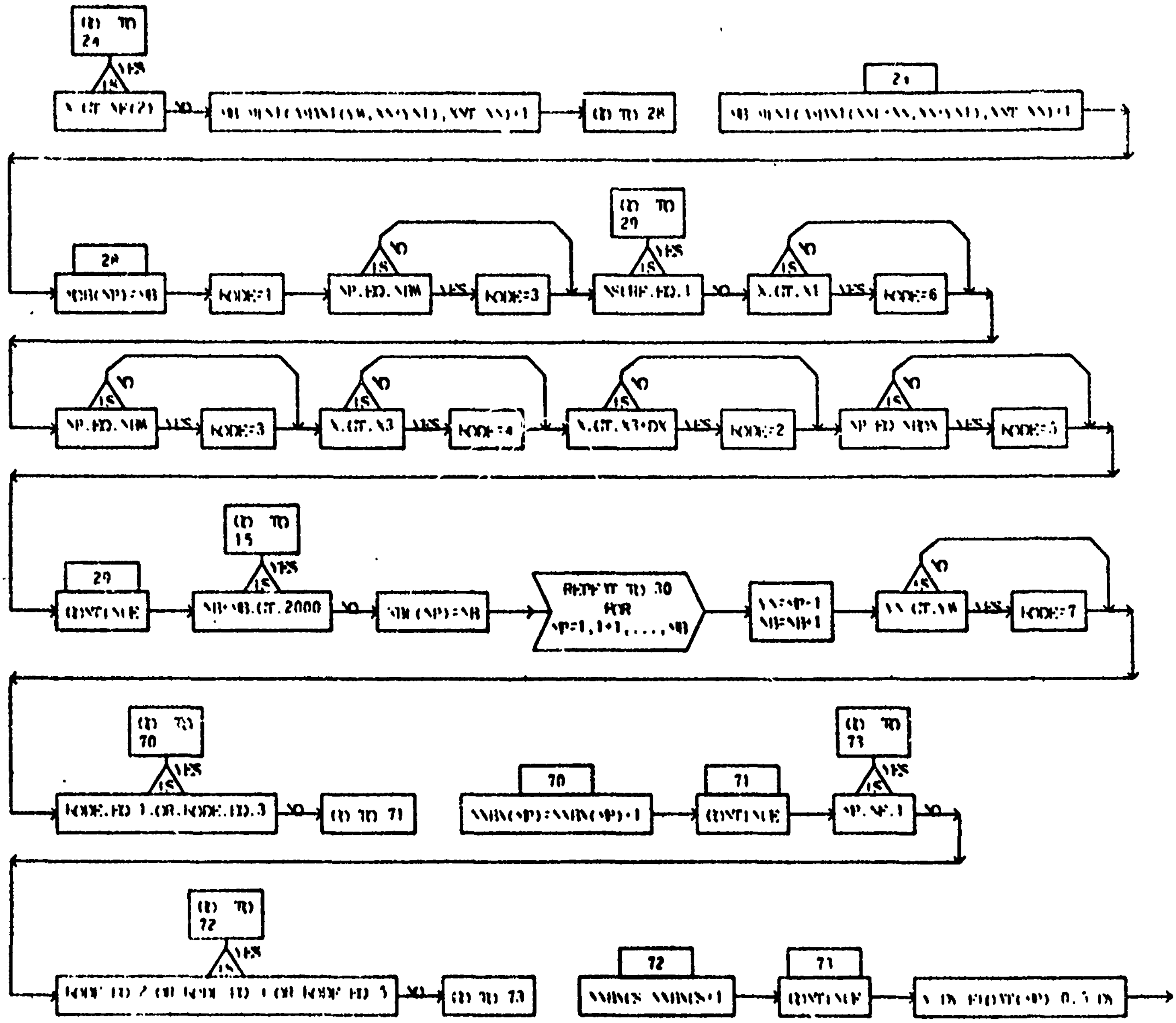

GO TO 15
YES
IS
NO
IR=0
REPEAT TO 21 FOR
21
GO TO 26
45
IR=0
REPEAT TO 22 FOR
22
REPEAT TO 23 FOR
23
26
GO TO 90
YES
NO
YES
NO
YES
COMPUTED GO TO
IF THE VALUE OF NODE IS
TRANSFER TO STATEMENT
1 128
2 121
3 128
4 121
5 121
6 127
7 127
128
IC=0

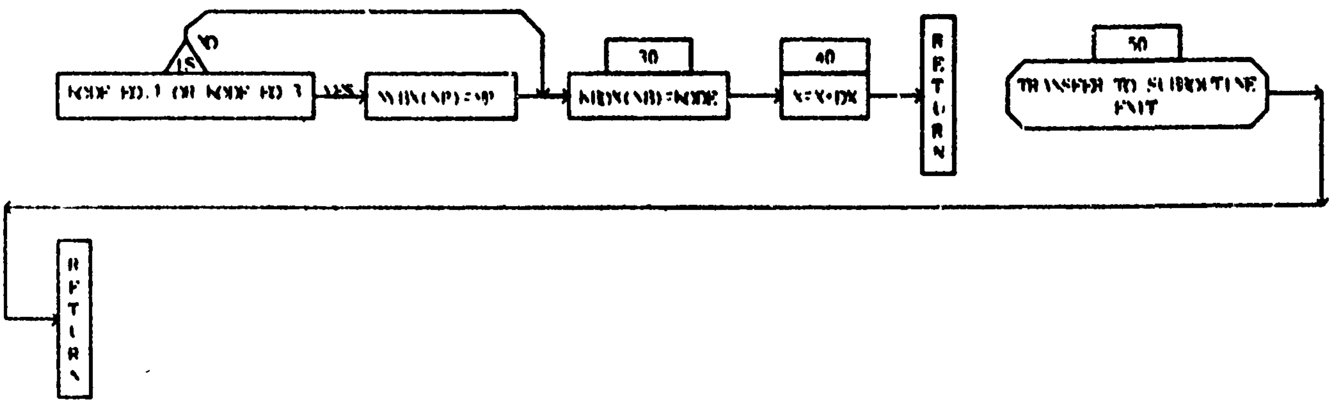

122
121
123
GO TO 126
IC=0
REPEAT TO 123
FOR
REPEAT TO 124
FOR
124
126
127
90
CONTINUE
CONTINUE
100
200
500
CONTINUE
TRANSFER TO SUBROUTINE
SD2
REPEAT TO 701
FOR
REPEAT TO 701
FOR
NO
YES
701
REPEAT TO 702
FOR
REPEAT TO 702
FOR
REPEAT TO 702
FOR
702
TRANSFER TO SUBROUTINE
FORCE
REPEAT TO 708
FOR
REPEAT TO 708
FOR
REPEAT TO 708
FOR


TRANSFER TO SUBROUTINE
900
CONTINUE
1000
CONTINUE




START
GO TO 50
YES
NO
GO TO 50
YES
NO
TWL=0.0
YES
GO TO 20
YES
NO
10
15
GO TO 10
20
REPEAT TO 40
FOR
40
REPEAT TO 40
FOR
NO
YES

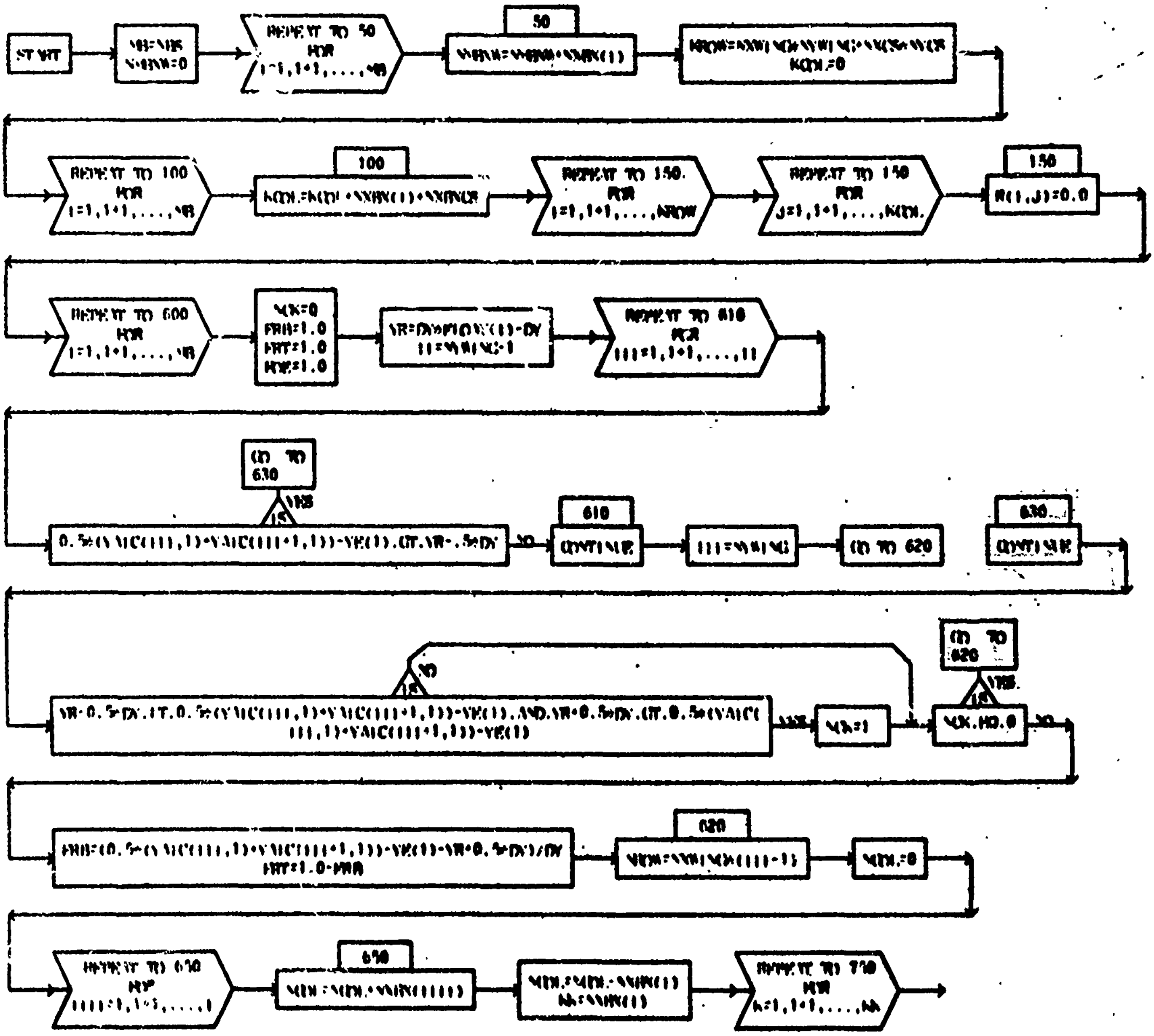


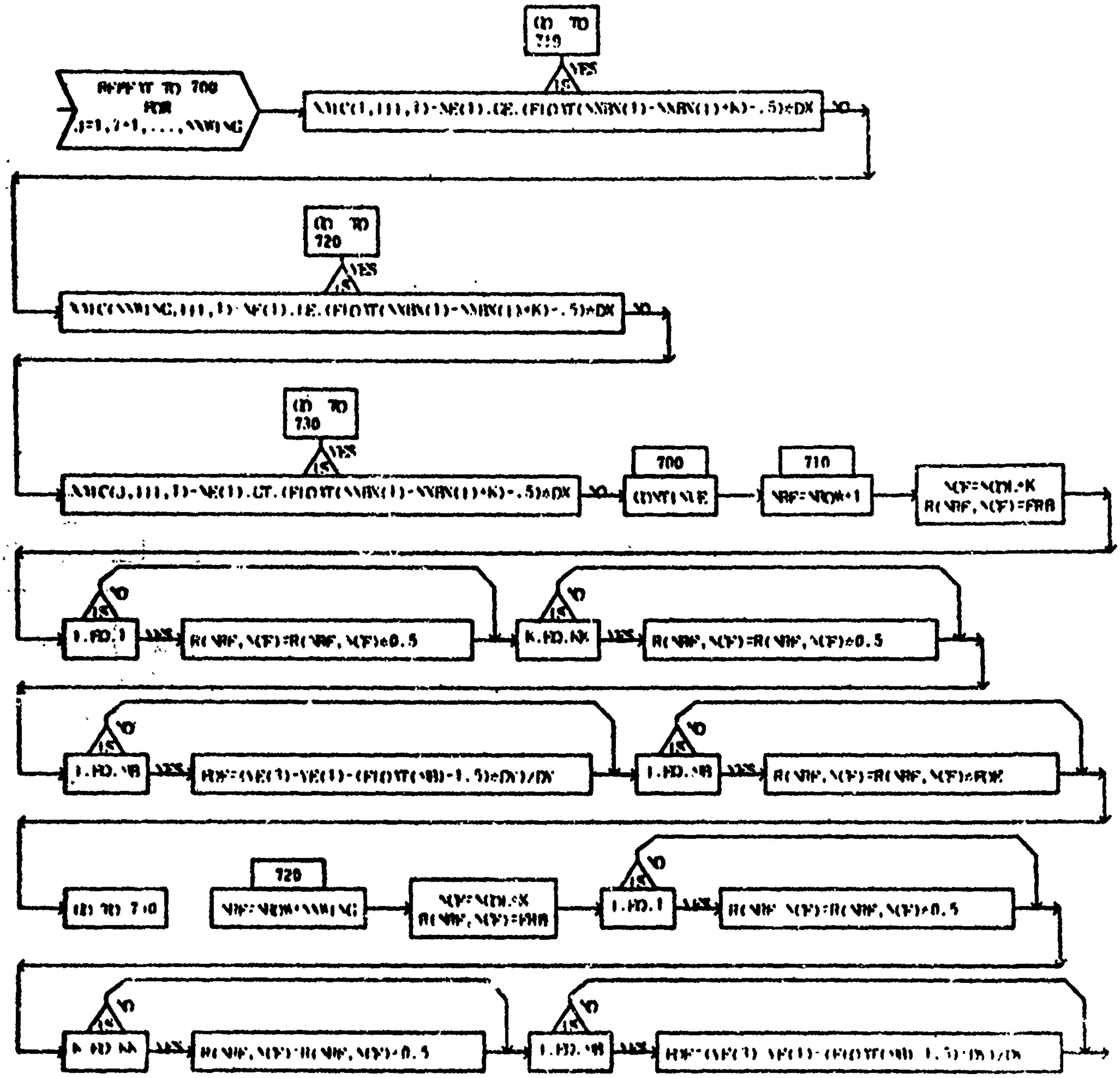

15
NO
YES
30
40
RETURN
50
TRANSFER TO SUBROUTINE EXIT
RETURN

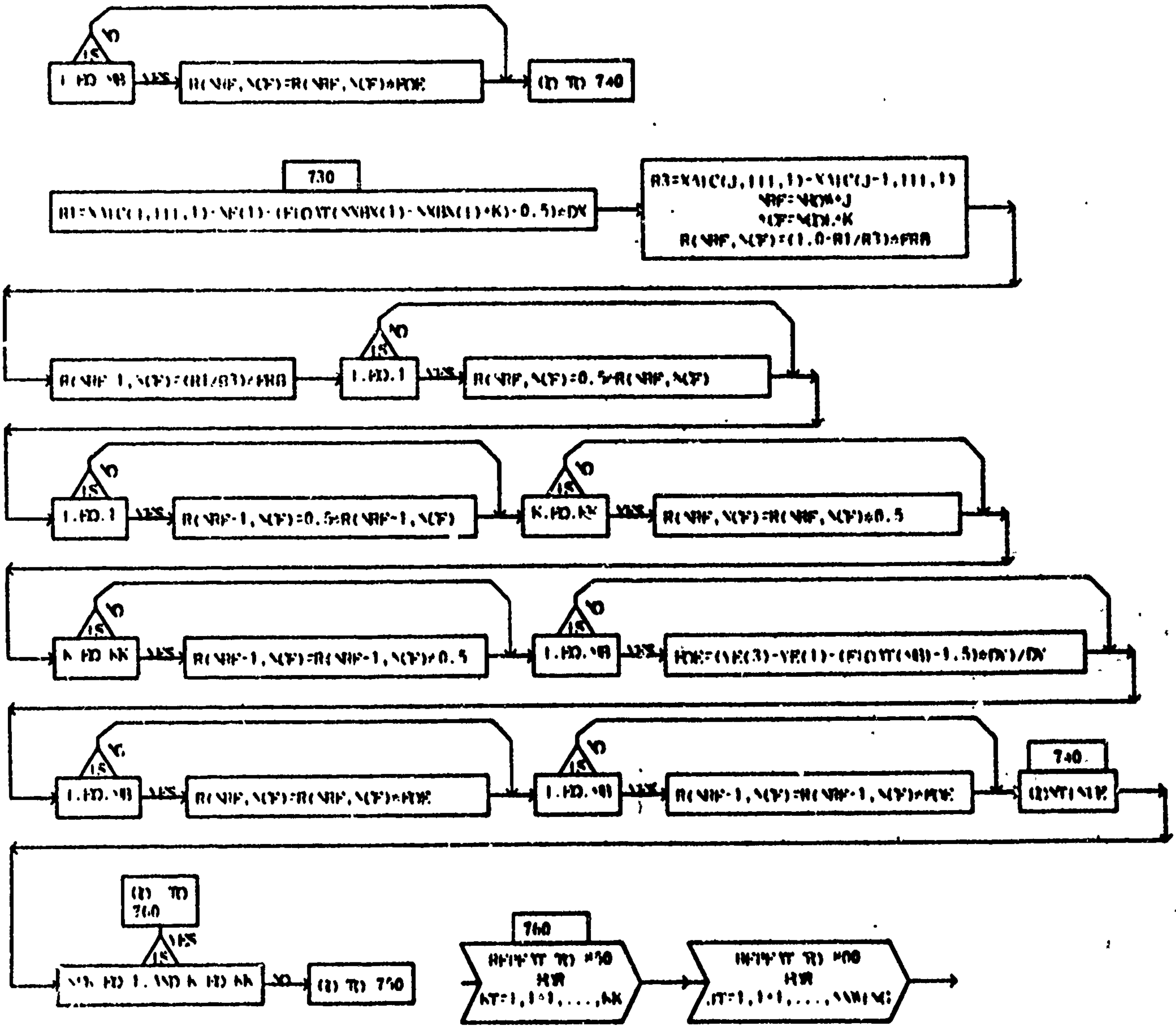
DIMENSIONED VARIABLES

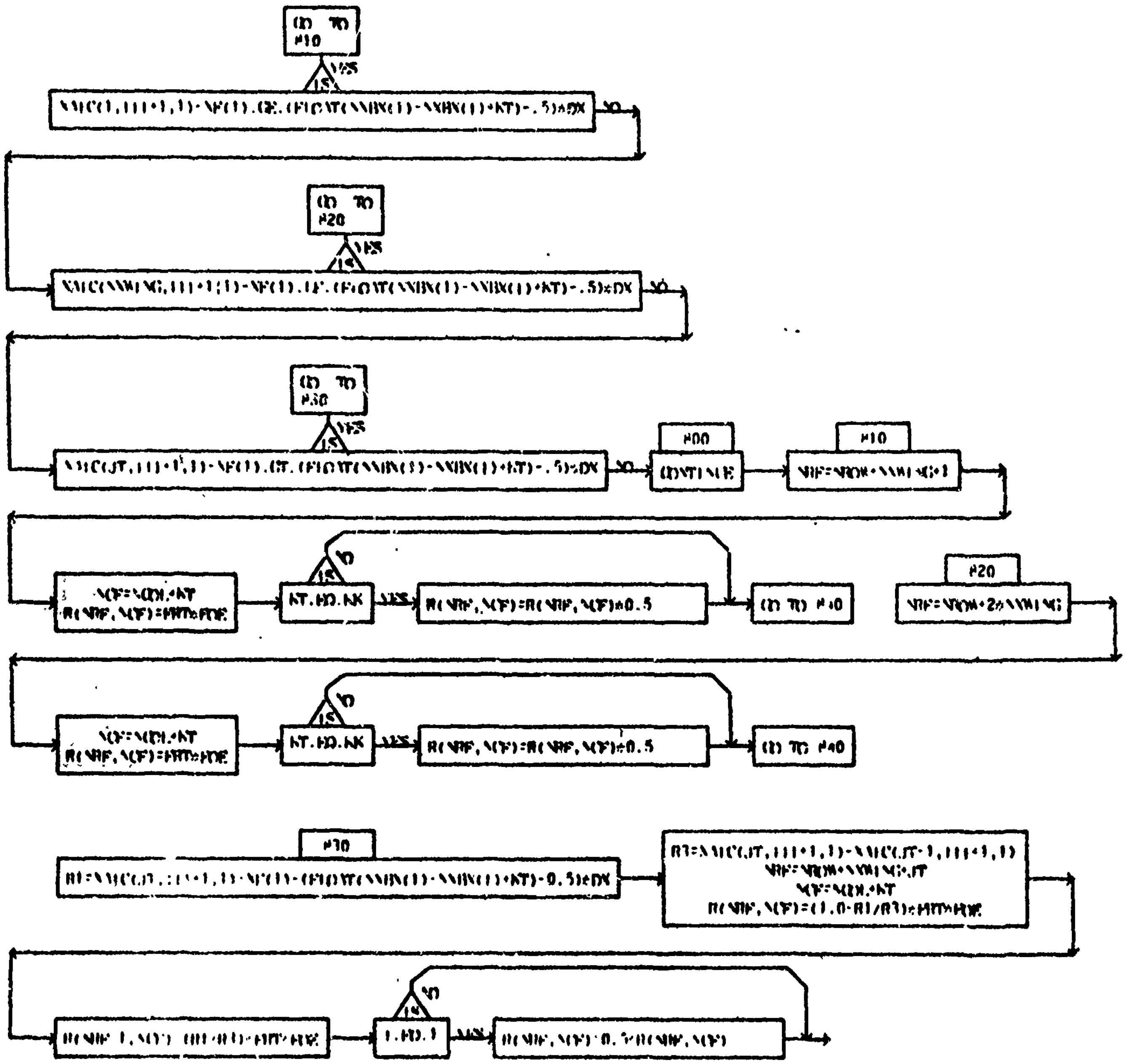
SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE
B	45,45								

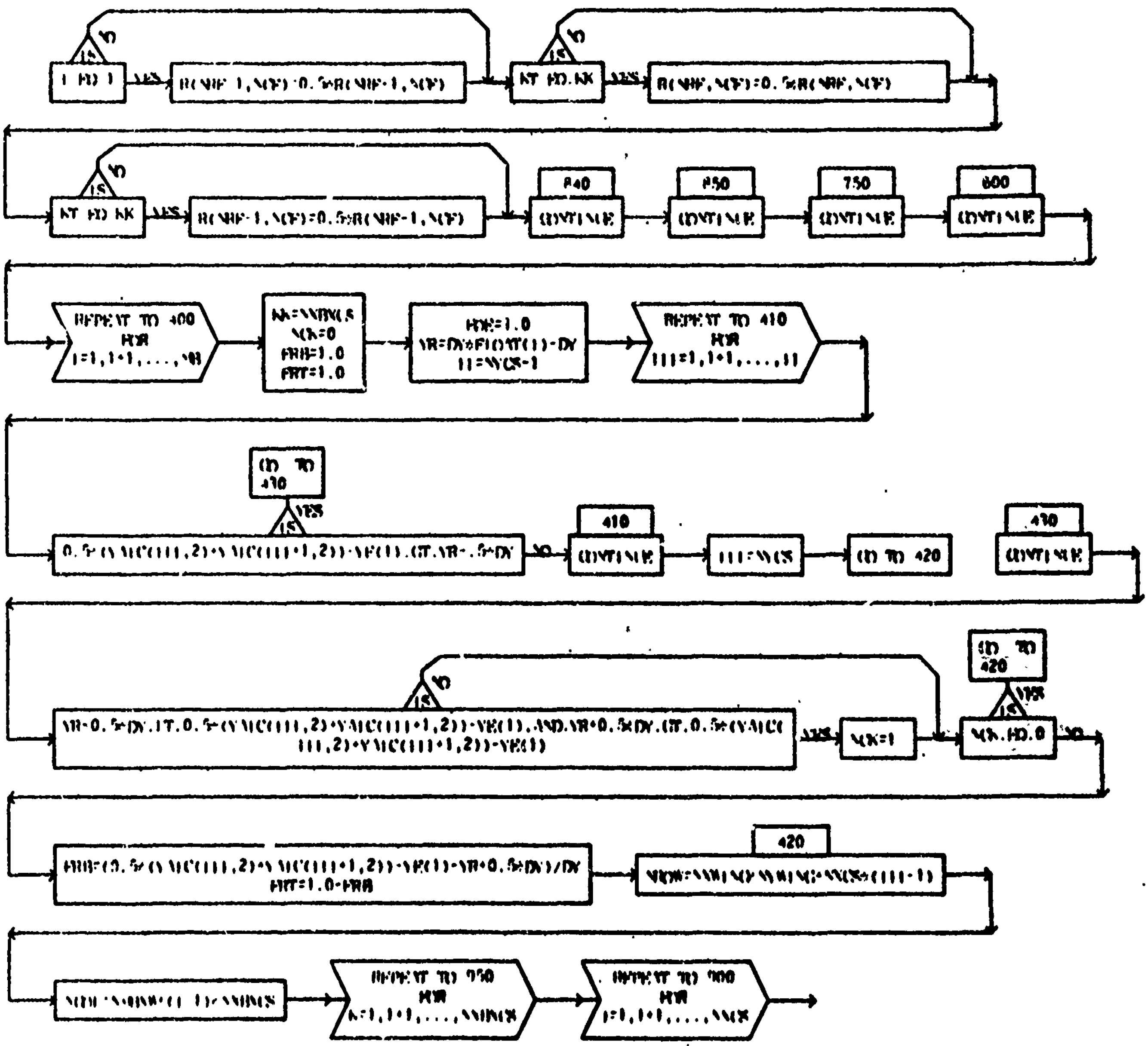
SUBROUTINE FORCE (R)

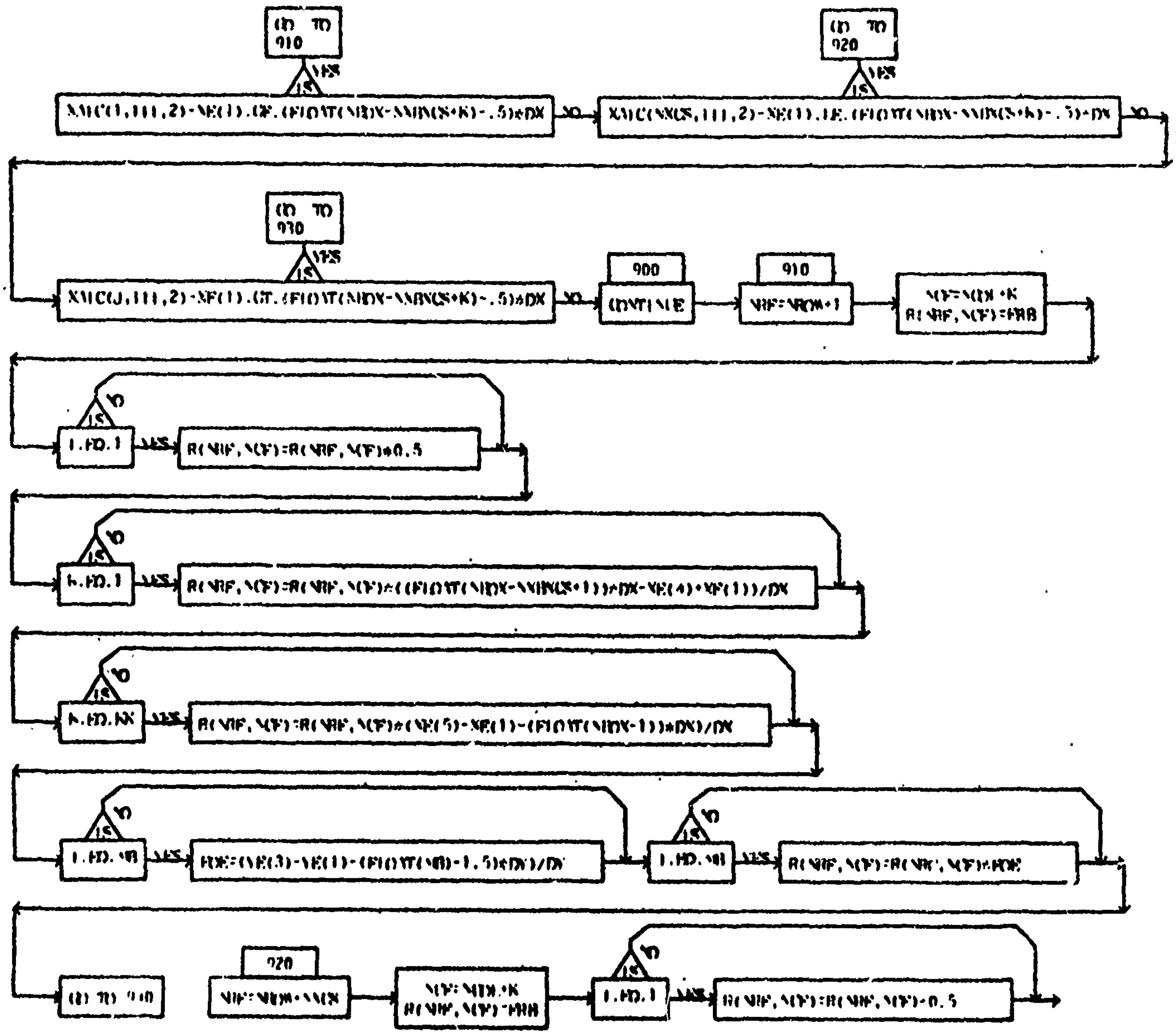


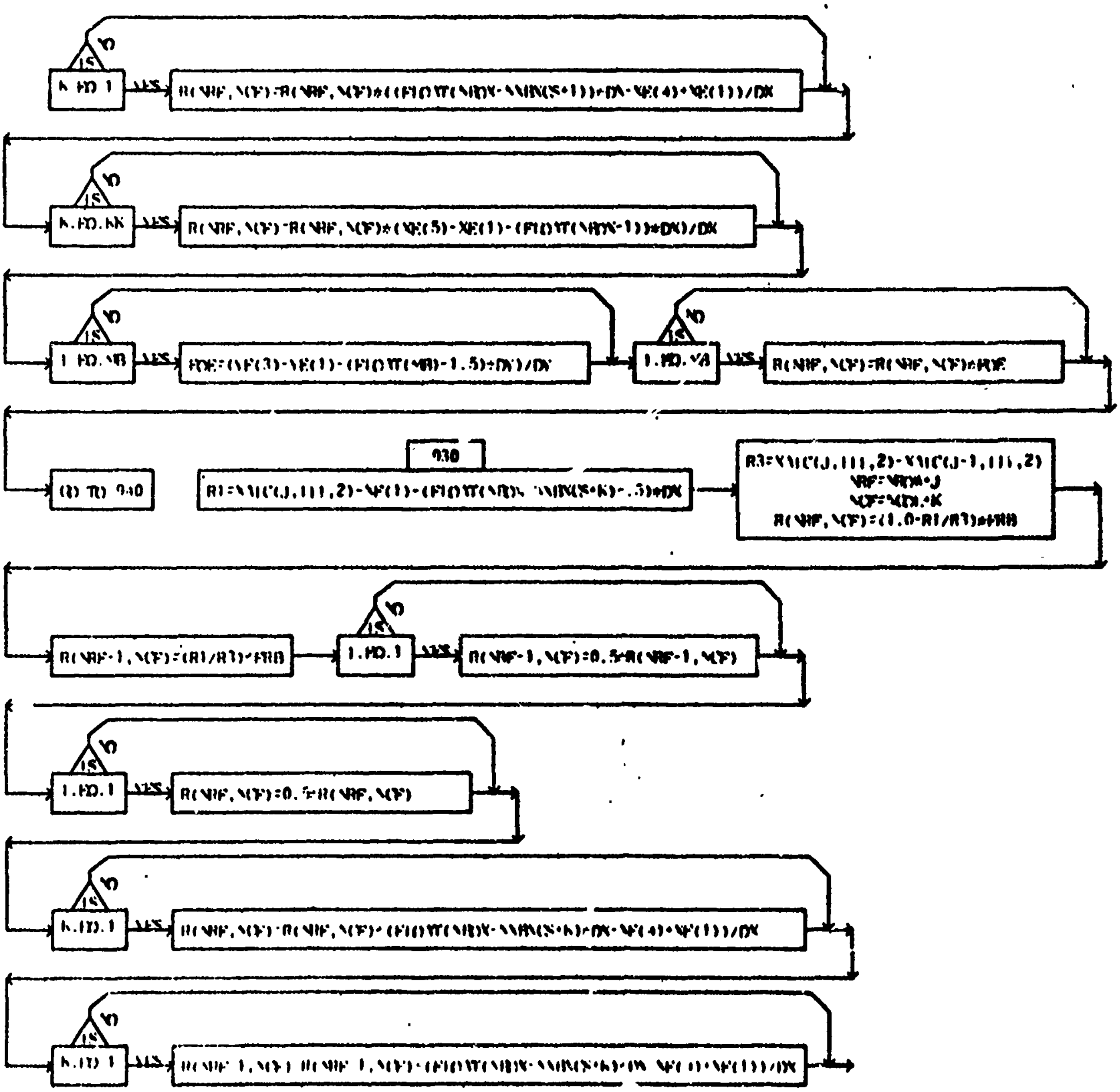

GO TO 710
YES
IS
REPEAT TO 700
FOR
NO
GO TO 720
GO TO 730
700
CONTINUE
710
720

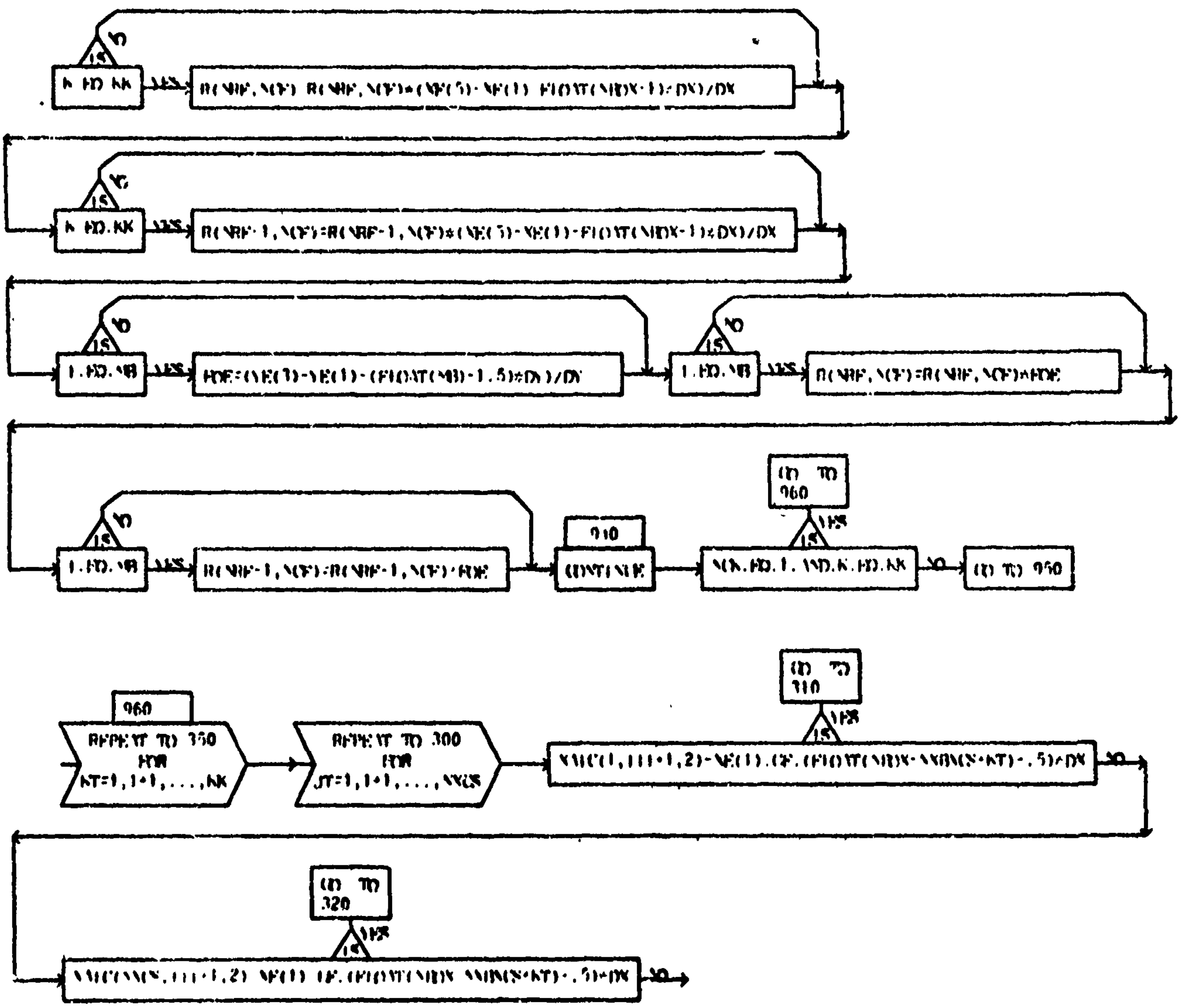


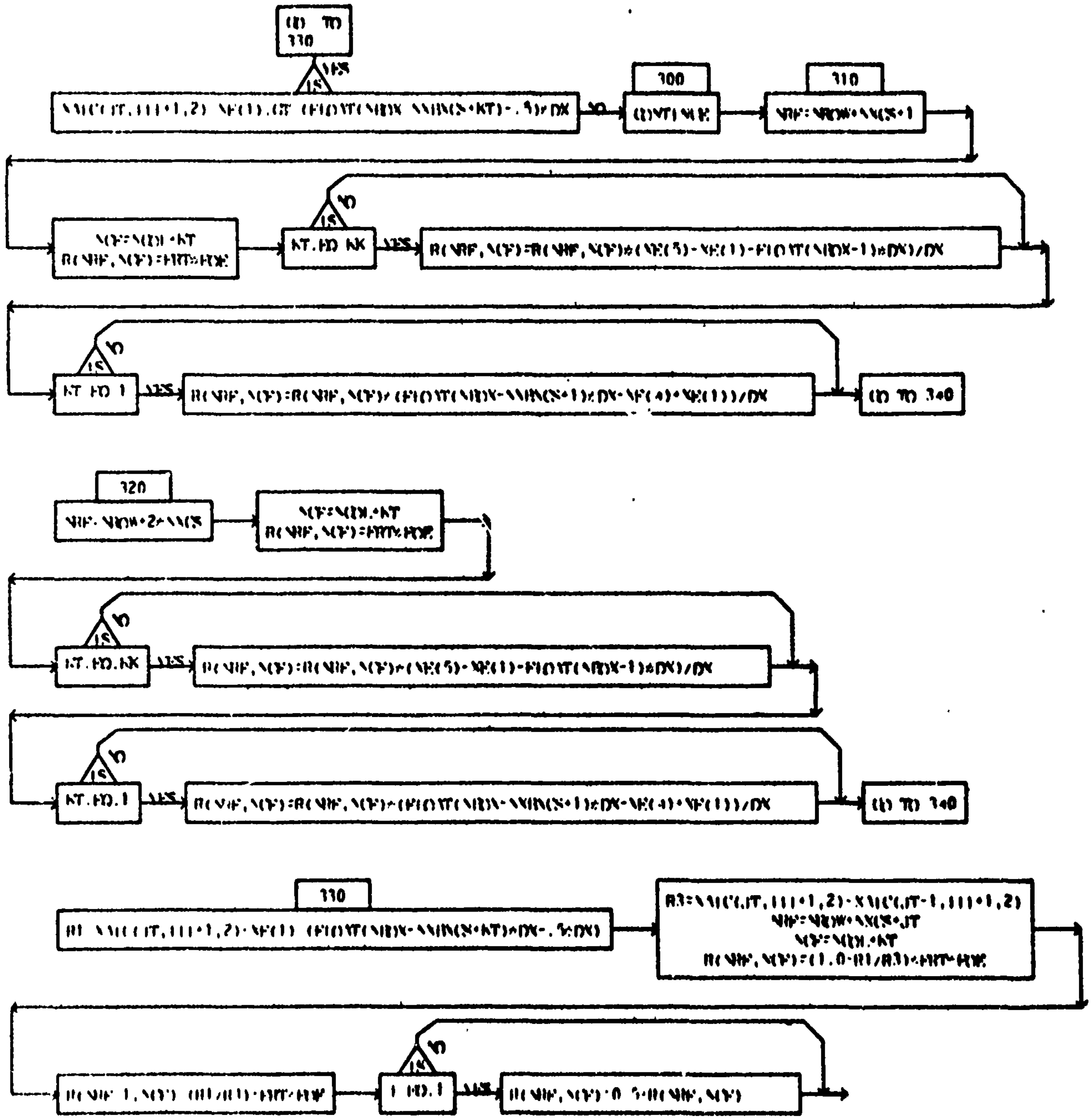

GO TO
#10
YES
IS
NO
GO TO
#20
GO TO
#30
#00
CONTINUE
#10
KT.EQ.NK
R(NRF,NCF)=R(NRF,NCF)*0.5
GO TO #40
#20
#30

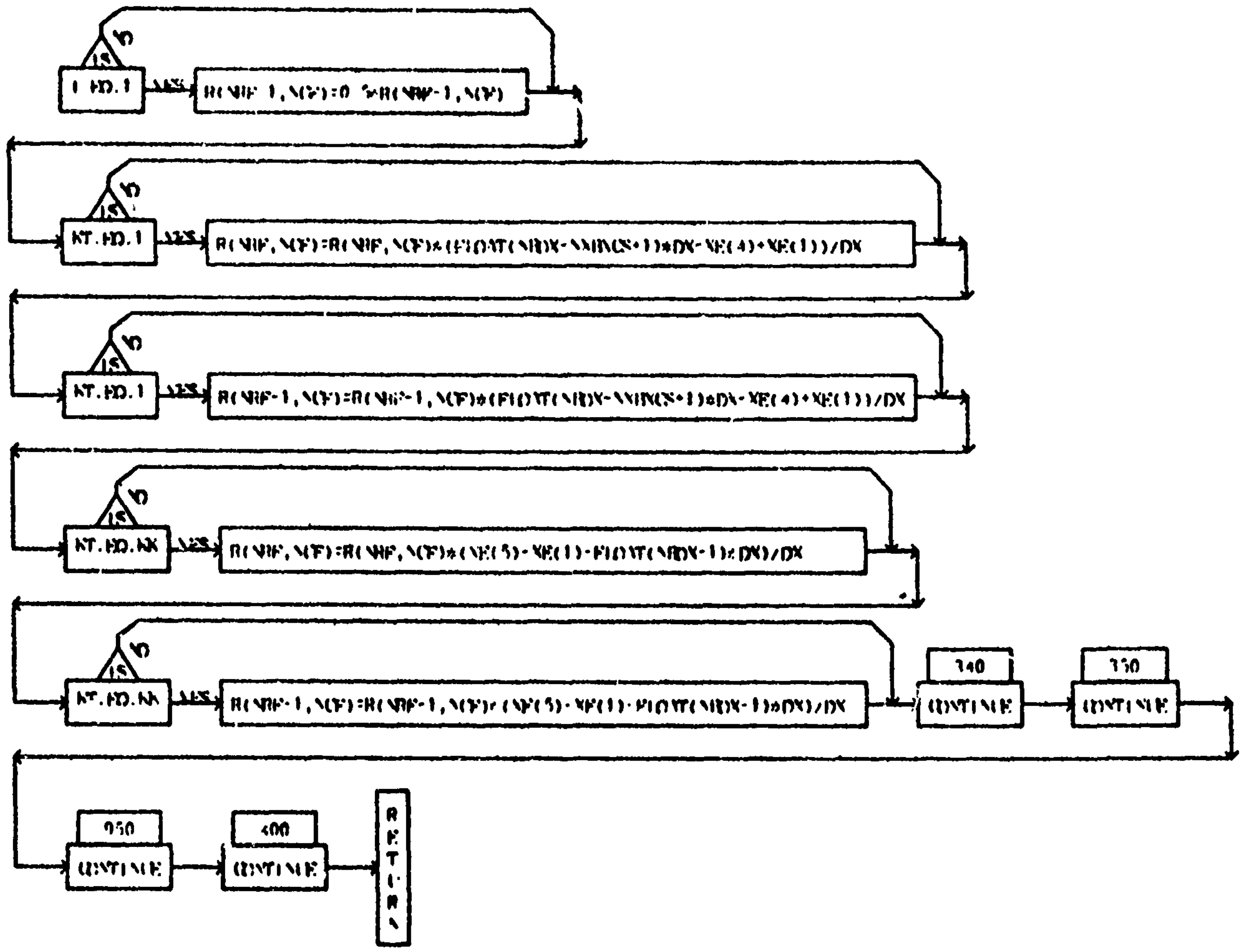

840
850
750
800
REPEAT TO 400
FOR
REPEAT TO 410
410
420
CONTINUE
YES
NO


GO TO 910
YES
IS
NO
GO TO 920
GO TO 930
900
CONTINUE
910
920


930
YES
NO
IS
R(NRF,NCF)=0.5*R(NRF,NCF)

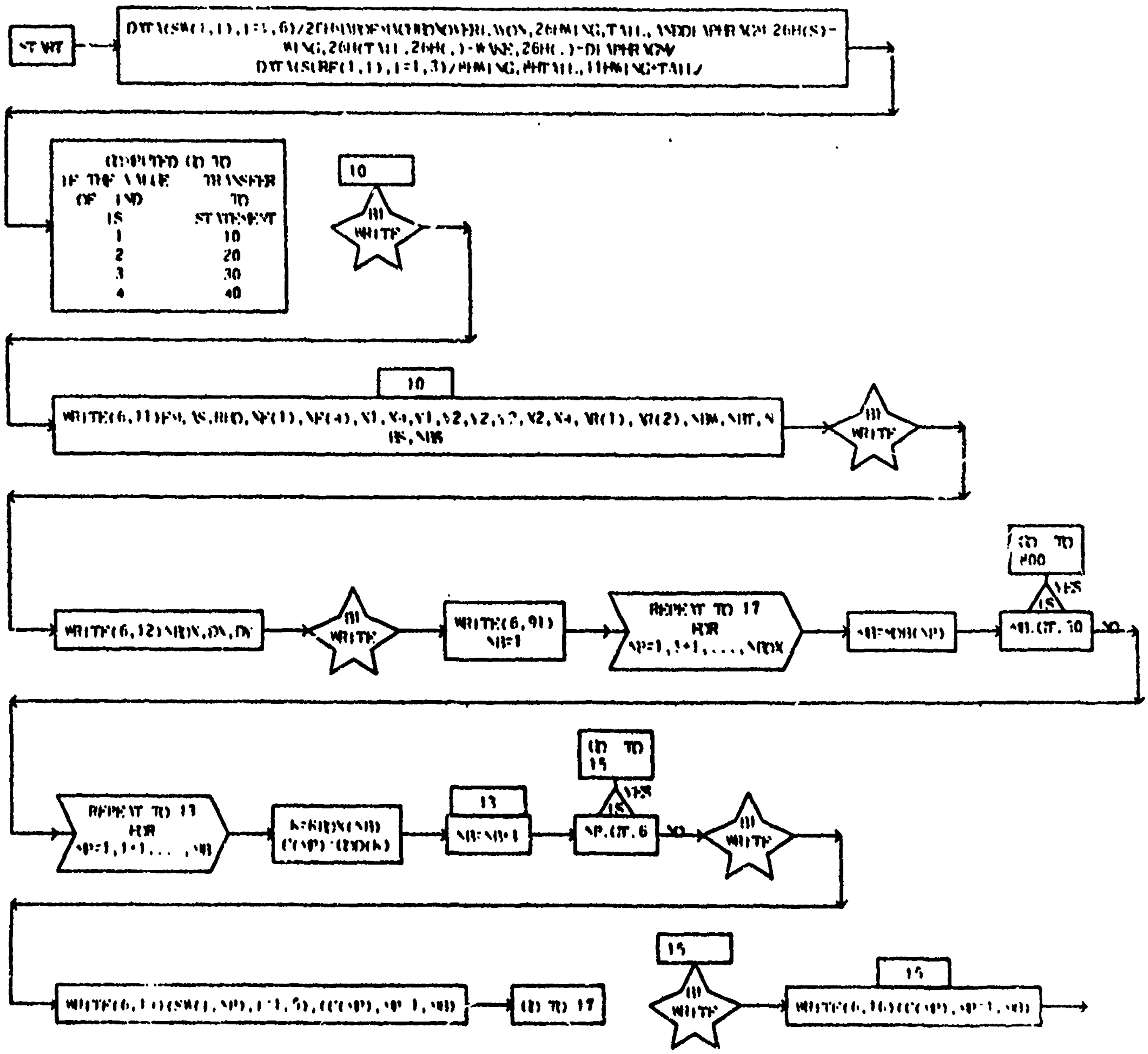

910
CONTINUE
960
GO TO 950

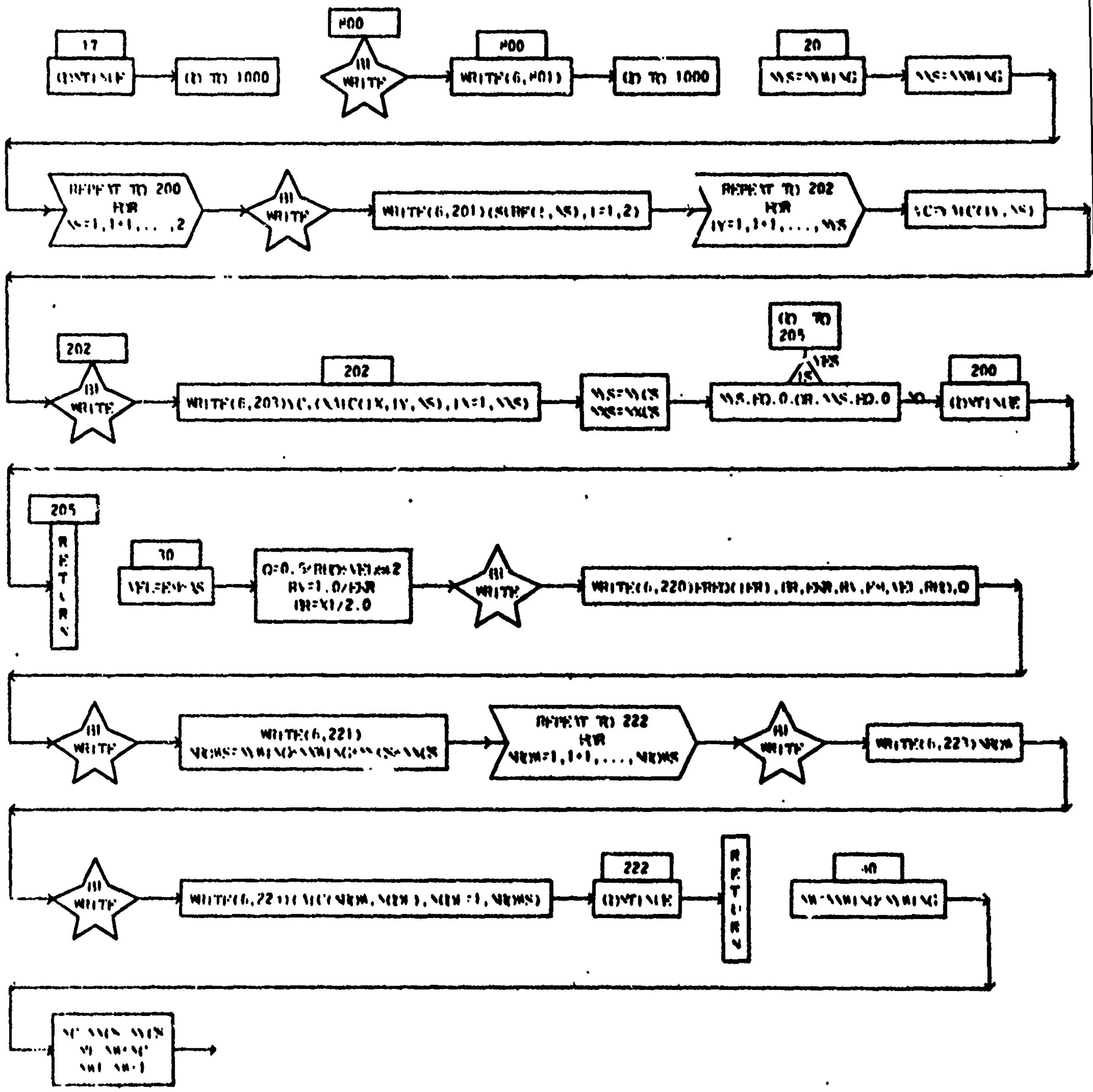

GO TO 330
YES
IS
300
CONTINUE
310
NO
KT.EQ.NK
KT.EQ.1
GO TO 340
320
330

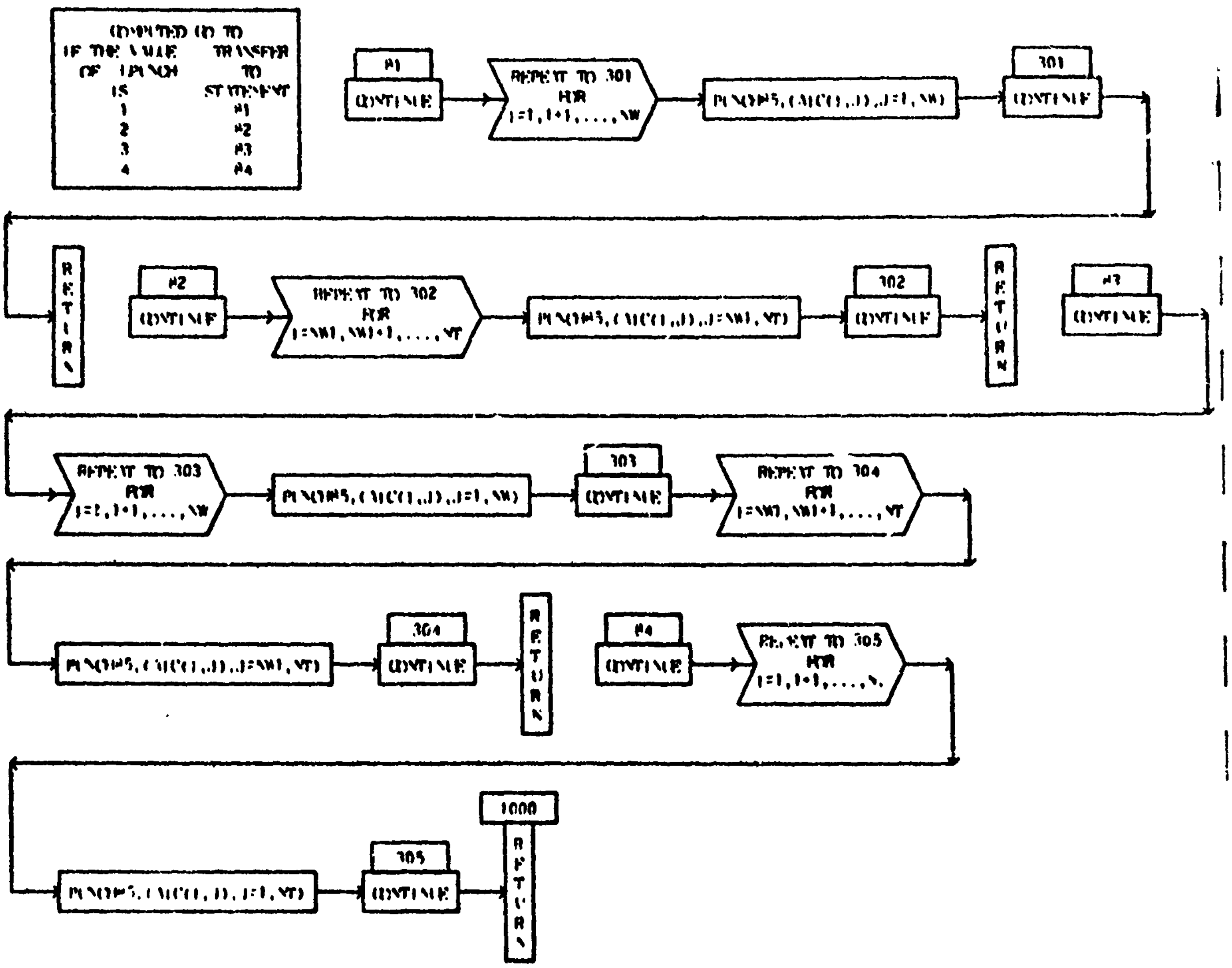

340
CONTINUE
CONTINUE
CONTINUE
400
CONTINUE

DIMENSIONED VARIABLES

SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
[illegible]	5,6	SUMF	2,3	[illegible]	7	C	30		

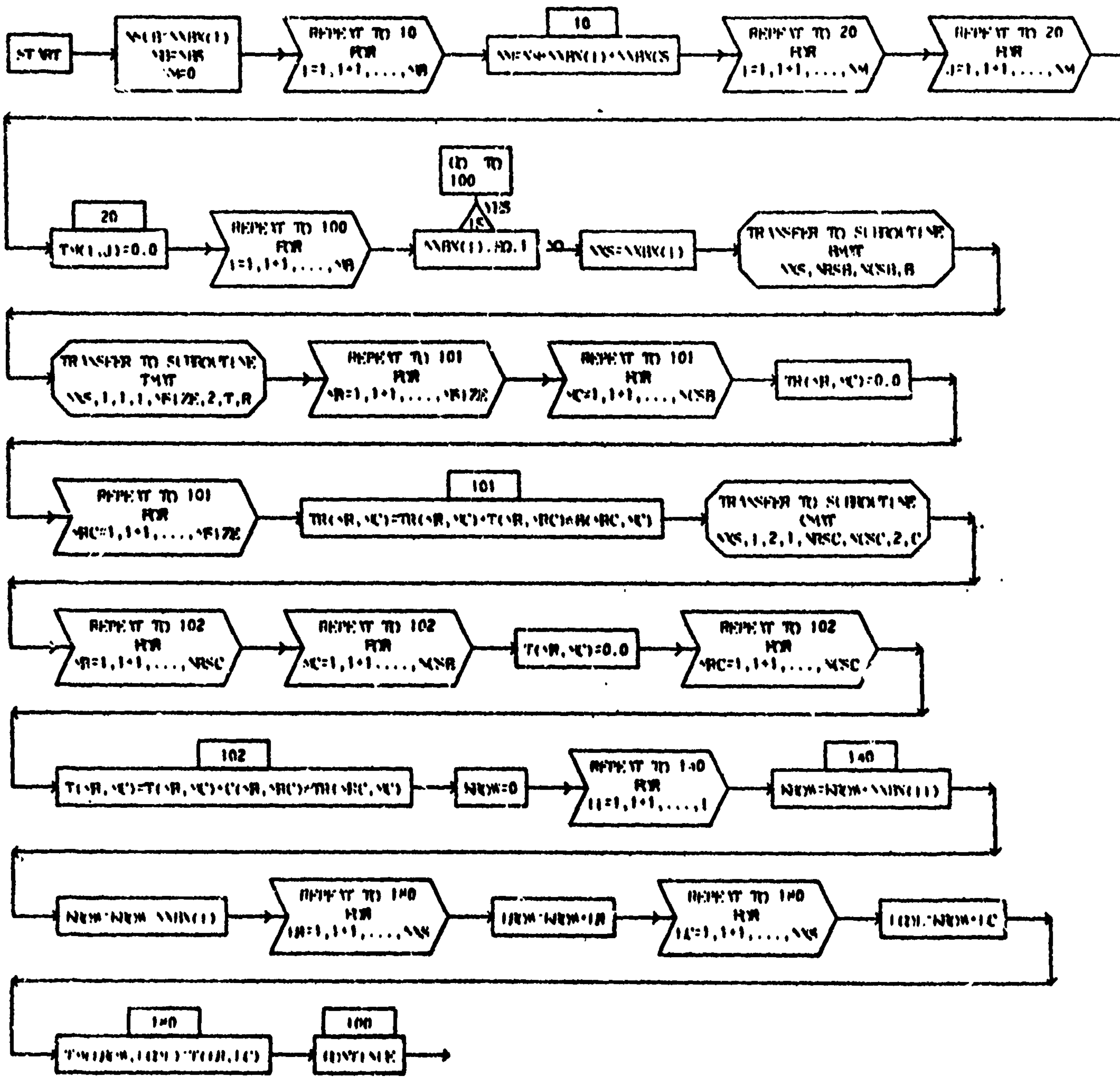

START
10
WRITE
WRITE
WRITE(6,91)
REPEAT TO 17
FOR
YES
NO
REPEAT TO 13
FOR
13
15
YES
NO
WRITE
15
WRITE
15

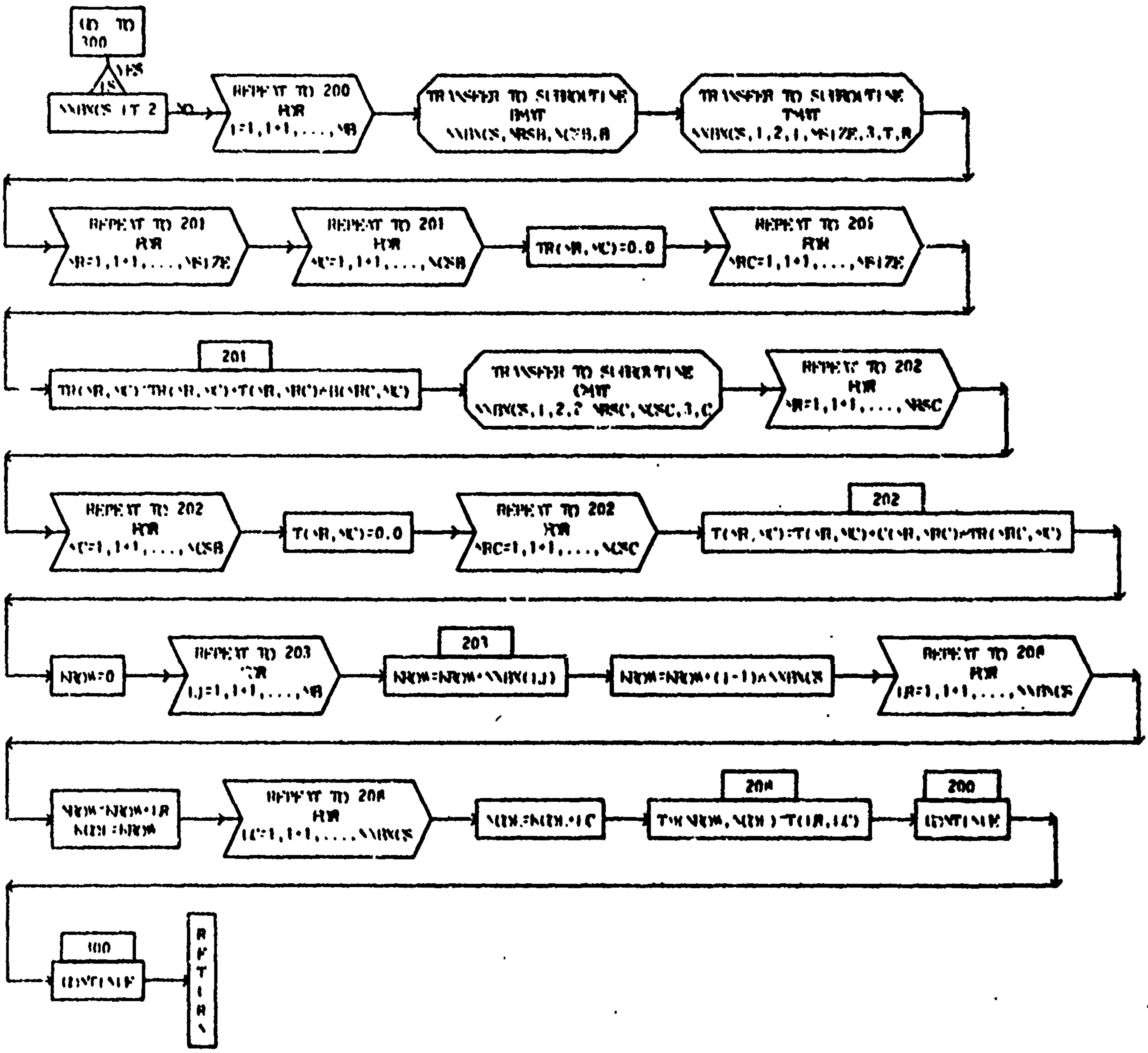

17
CONTINUE
GO TO 1000
800
WRITE
800
WRITE(6,801)
GO TO 1000
20
REPEAT TO 200
FOR
WRITE
REPEAT TO 202
FOR
202
WRITE
202
GO TO
205
200
CONTINUE
205
RETURN
30
WRITE
WRITE
WRITE(6,221)
REPEAT TO 222
FOR
WRITE
WRITE
222
CONTINUE
RETURN
40


COMPUTED GO TO
IF THE VALUE OF IPUNCH IS
TRANSFER TO STATEMENT
1 #1
2 #2
3 #3
4 #4
#1
CONTINUE
REPEAT TO 301 FOR
301
CONTINUE
RETURN
#2
CONTINUE
REPEAT TO 302 FOR
302
CONTINUE
RETURN
#3
CONTINUE
REPEAT TO 303 FOR
303
CONTINUE
REPEAT TO 304 FOR
304
CONTINUE
RETURN
#4
CONTINUE
REPEAT TO 305 FOR
305
CONTINUE
1000
RETURN

DIMENSIONED VARIABLES

SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
S	45,45	R	45,45	C	45,45	B	45,45	T	45,45
TR	45,45	TM	45,45						

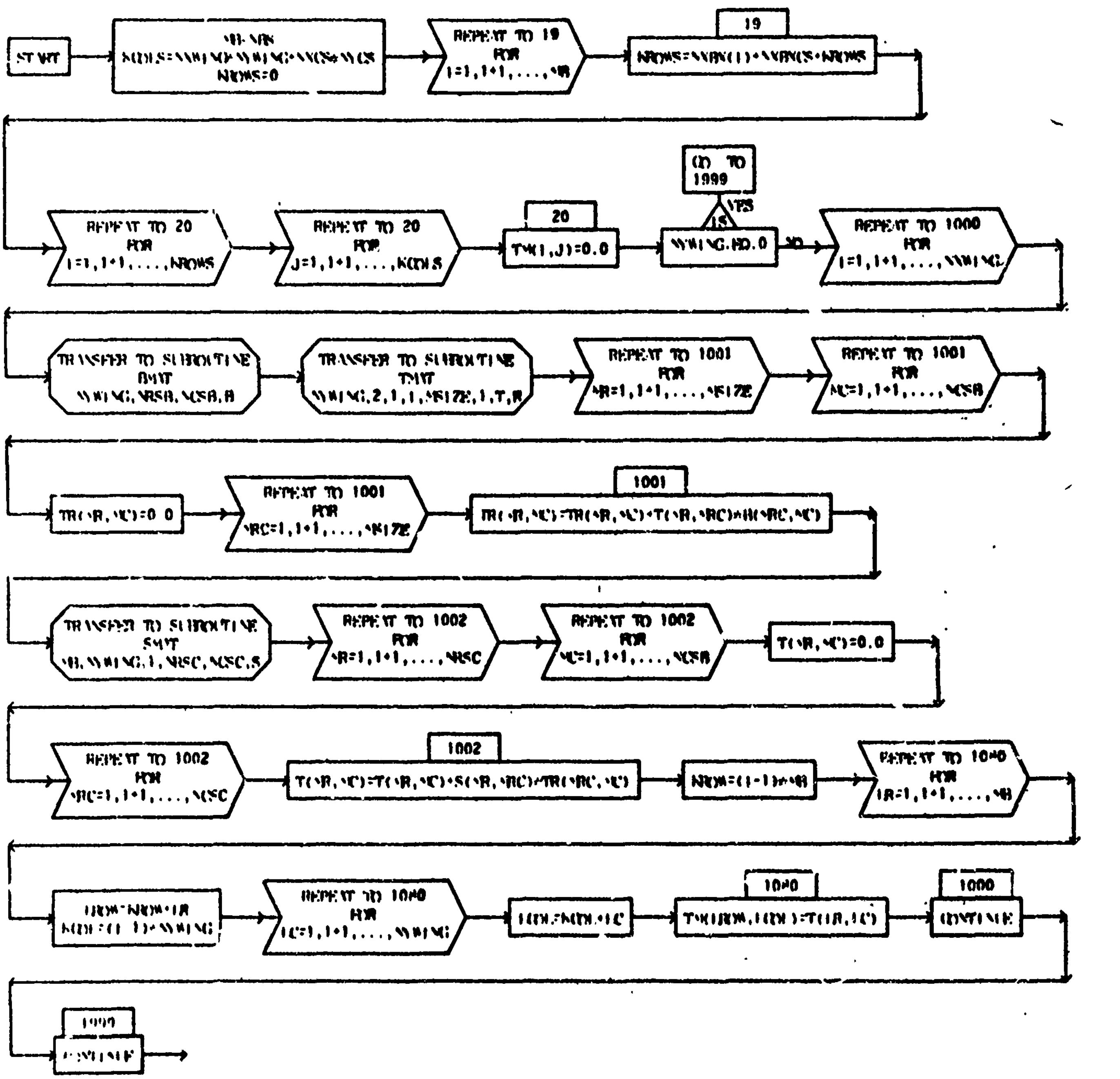

START
REPEAT TO 10 FOR
10
REPEAT TO 20 FOR
20
T(I,J)=0.0
REPEAT TO 100 FOR
TRANSFER TO SUBROUTINE
REPEAT TO 101 FOR
101
REPEAT TO 102 FOR
102
T(R,C)=0.0
NROW=0
140
CONTINUE

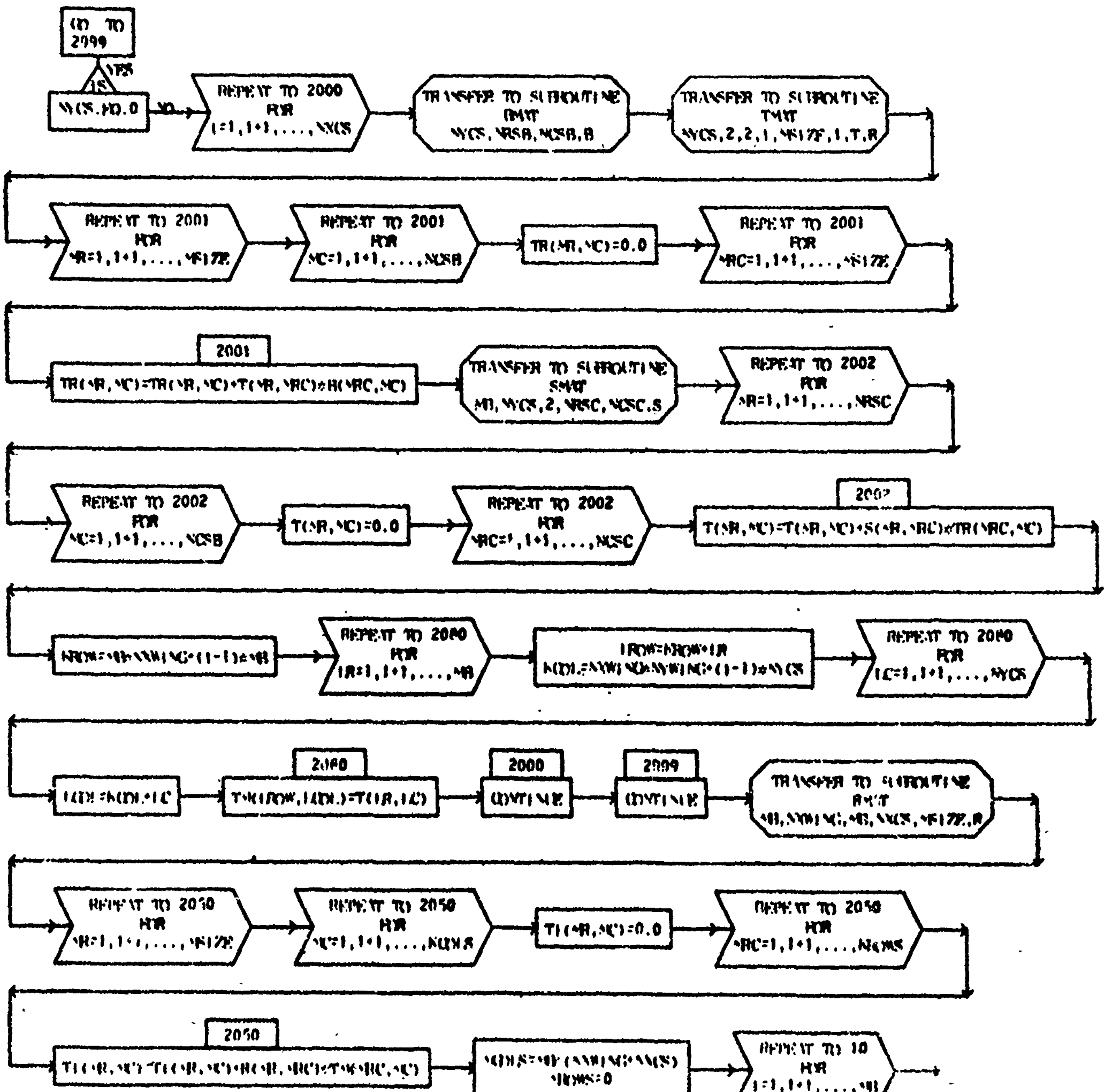

GO TO 300
YES
NO
REPEAT TO 200
FOR
TRANSFER TO SUBROUTINE
REPEAT TO 201
FOR
REPEAT TO 201
FOR
TR(NR,NC)=0.0
REPEAT TO 201
FOR
201
TRANSFER TO SUBROUTINE
REPEAT TO 202
FOR
REPEAT TO 202
FOR
T(NR,NC)=0.0
REPEAT TO 202
FOR
202
NROW=0
REPEAT TO 203
FOR
203
REPEAT TO 208
FOR
REPEAT TO 208
FOR
208
200
300
RETURN

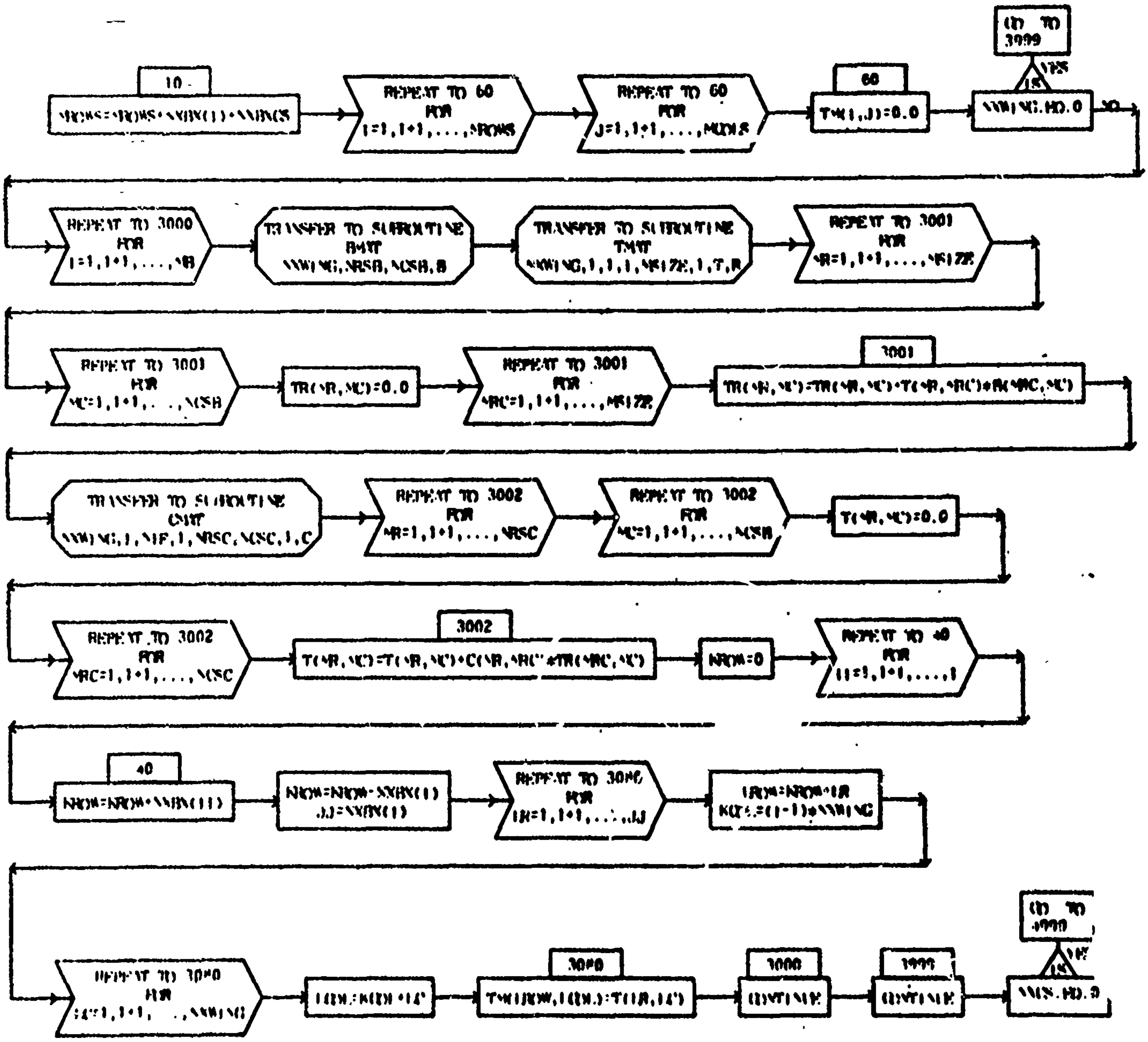
DIMENSIONED VARIABLES

SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
S	45,45	R	45,45	C	45,45	B	45,45	T	45,45
TR	45,45	TI	45,45	TM	45,45				

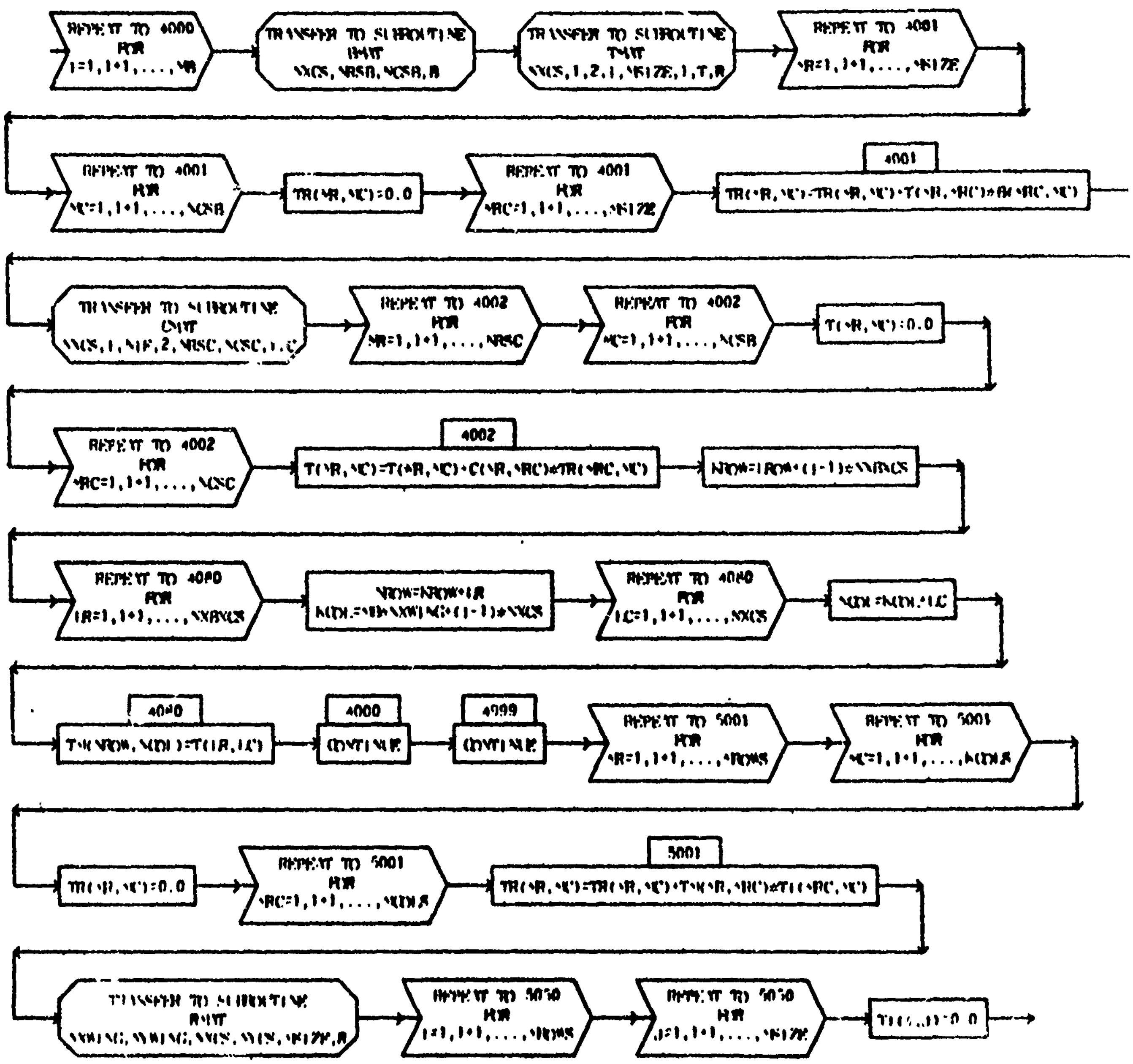
SUBROUTINE TRAMP (NIF,NROWS,KOLS,S,B,C,H,T,TR,TI,TM) PAGE 1

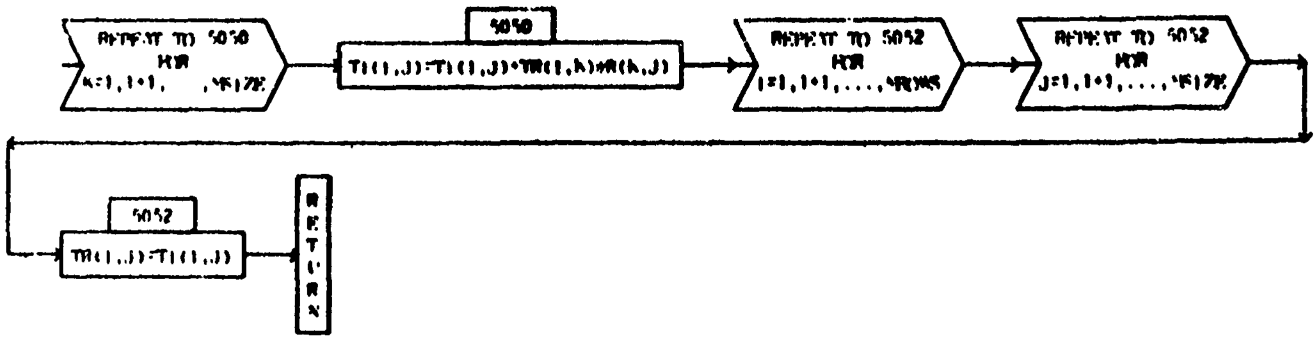


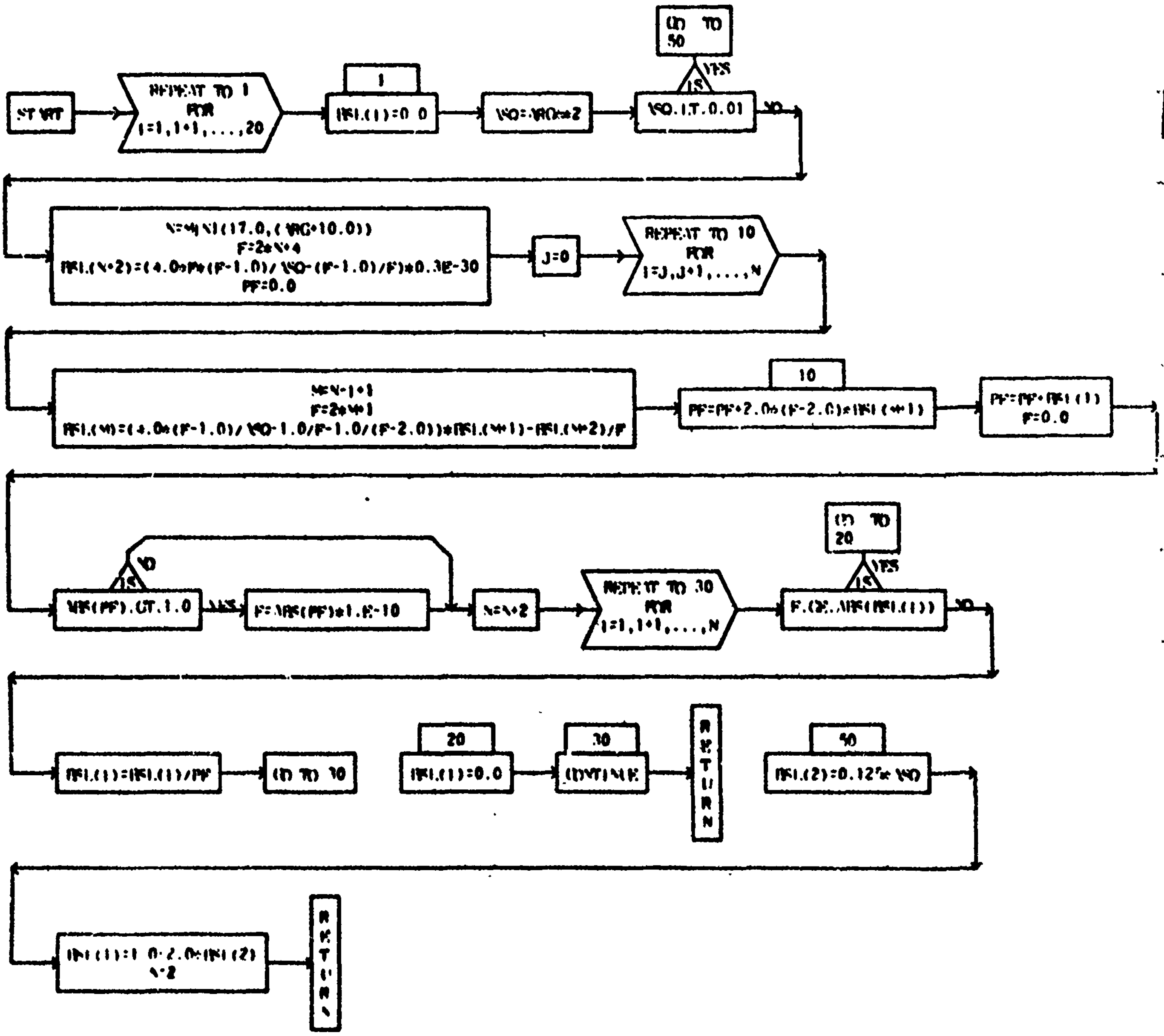

GO TO 2999
YES
IS
NO
REPEAT TO 2000 FOR
TRANSFER TO SUBROUTINE
REPEAT TO 2001 FOR
TR(MR,MC)=0.0
2001
REPEAT TO 2002 FOR
T(MR,MC)=0.0
REPEAT TO 2080 FOR
2080
2000
CONTINUE
2999
REPEAT TO 2050 FOR
2050
REPEAT TO 10 FOR


10
REPEAT TO 60 FOR
REPEAT TO 60 FOR
60
GO TO 3999
YES
15
NO
REPEAT TO 3000 FOR
TRANSFER TO SUBROUTINE
TRANSFER TO SUBROUTINE
REPEAT TO 3001 FOR
REPEAT TO 3001 FOR
TR(NR,NC)=0.0
REPEAT TO 3001 FOR
3001
TRANSFER TO SUBROUTINE
REPEAT TO 3002 FOR
REPEAT TO 3002 FOR
T(NR,NC)=0.0
REPEAT TO 3002 FOR
3002
NROW=0
REPEAT TO 40 FOR
40
REPEAT TO 3080 FOR
REPEAT TO 3080 FOR
3080
3000
3999
CONTINUE
CONTINUE
GO TO 4999

SUBROUTINE TRANSP (NIF, NROWS, KCOLS, S, R, C, B, T, TR, TI, TN)

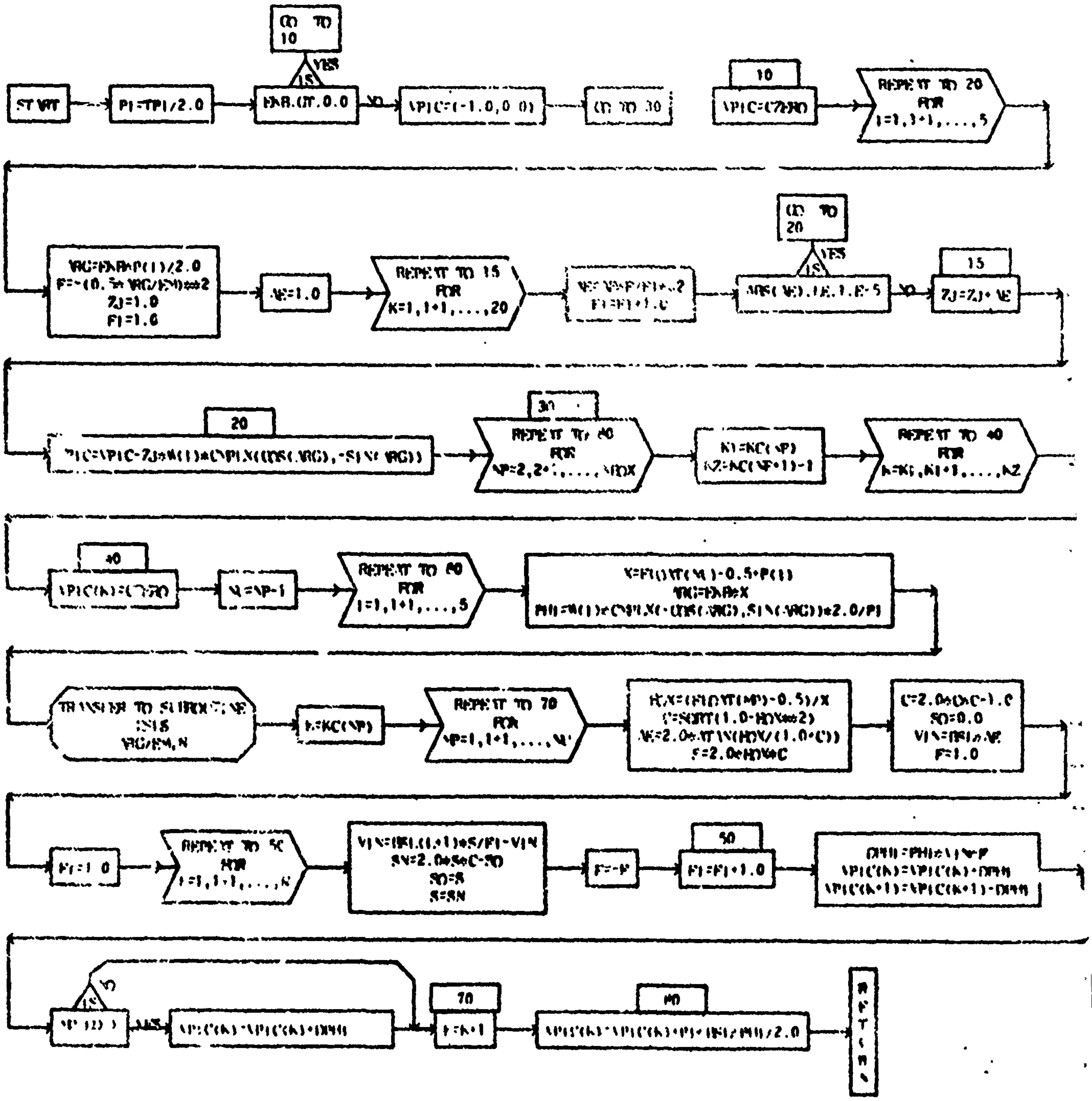


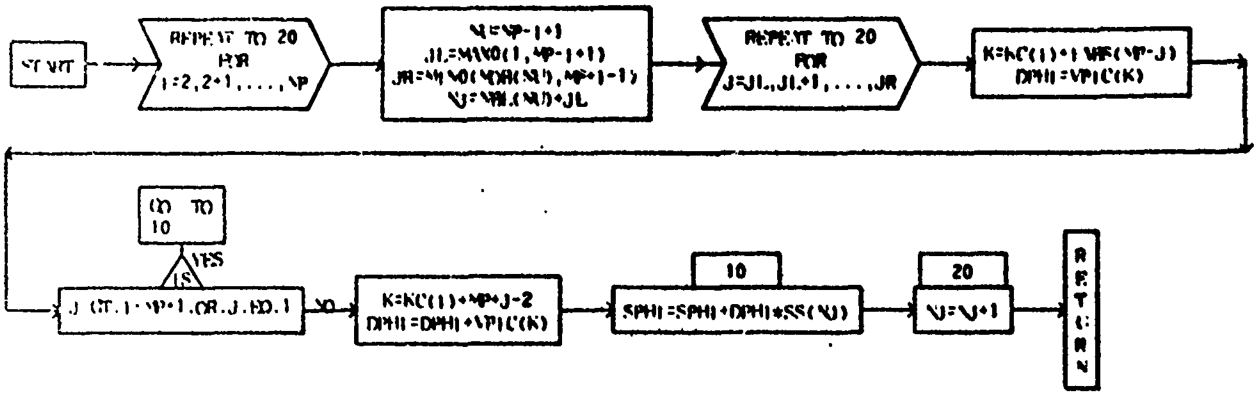

REPEAT TO 5050
FOR
K=1,1+1, ,NSIZE
5050
T1(I,J)=T1(I,J)+TR(I,K)*R(K,J)
REPEAT TO 5052
FOR
I=1,1+1,...,NROWS
REPEAT TO 5052
FOR
J=1,1+1,...,NSIZE
5052
TR(I,J)=T1(I,J)
RETURN

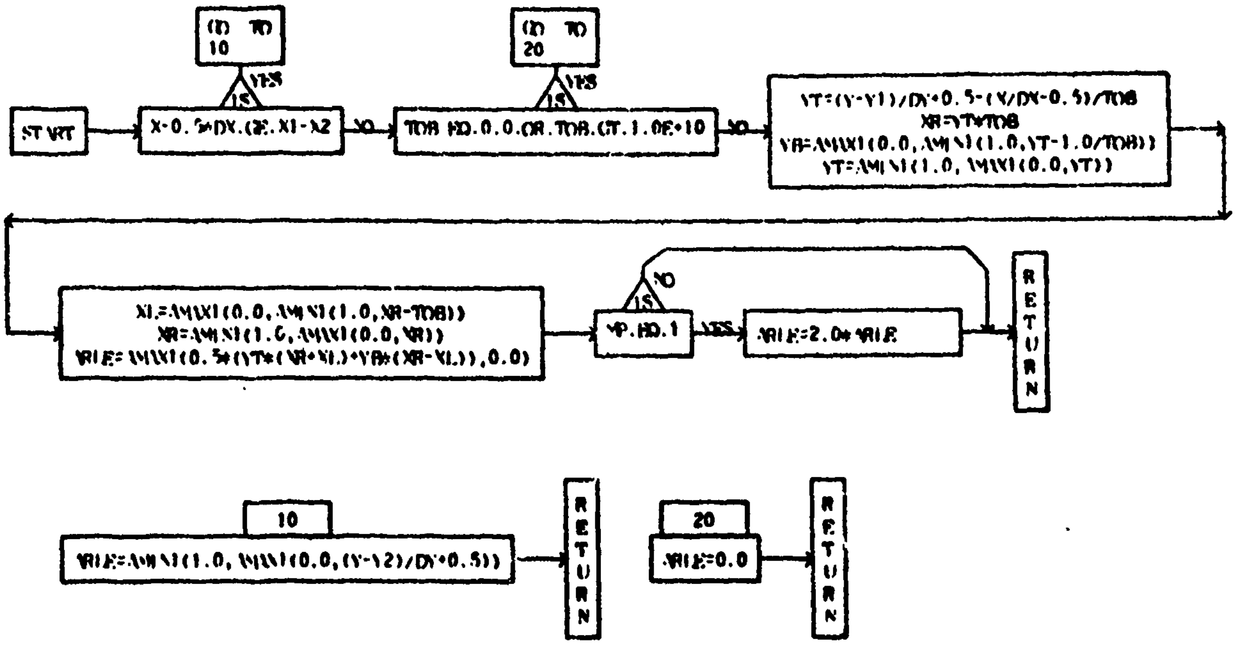

START
REPEAT TO 1
FOR
I=1,I+1,...,20
1
BESL(I)=0.0
ASQ=ARG**2
IS
ASQ.LT.0.01
YES
GO TO
50
NO
N=MINI(17.0,(ARG+10.0))
F=2*N+4
BESL(N+2)=(4.0*F*(F-1.0)/ASQ-(F-1.0)/F)*0.3E-30
PF=0.0
J=0
REPEAT TO 10
FOR
I=J,J+1,...,N
M=N-I+1
F=2*M+1
BESL(M)=(4.0*(F-1.0)/ASQ-1.0/F-1.0/(F-2.0))*BESL(M+1)-BESL(M+2)/F
10
PF=PF+2.0*(F-2.0)*BESL(M+1)
PF=PF+BESL(1)
F=0.0
IS
ABS(PF).GT.1.0
NO
YES
F=ABS(PF)*1.E-10
N=N+2
REPEAT TO 30
FOR
I=1,I+1,...,N
IS
F.GE.ABS(BESL(I))
YES
GO TO
20
NO
BESL(I)=BESL(I)/PF
GO TO 30
20
BESL(I)=0.0
30
CONTINUE
RETURN
50
BESL(2)=0.125*ASQ
BESL(1)=1.0-2.0*BESL(2)
N=2
RETURN

D I M E N S I O N E D   V A R I A B L E S

SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE	SYMBOL	STORAGE
P	5	W	5						


START
PI=TPI/2.0
GO TO 10
YES
IS
NO
VPIC=(-1.0,0.0)
GO TO 30
10
VPIC=CZERO
REPEAT TO 20 FOR I=1,I+1,...,5
GO TO 20
REPEAT TO 15 FOR K=1,1+1,...,20
15
ZJ=1.0
FI=1.0
AE=1.0
20
30
REPEAT TO 40
40
VPIC(K)=CZERO
REPEAT TO 80 FOR I=1,I+1,...,5
TRANSFER TO SUBROUTINE
REPEAT TO 70
C=2.0
S0=0.0
F=1.0
REPEAT TO 50
50
S0=S
S=SN
70
80
RETURN

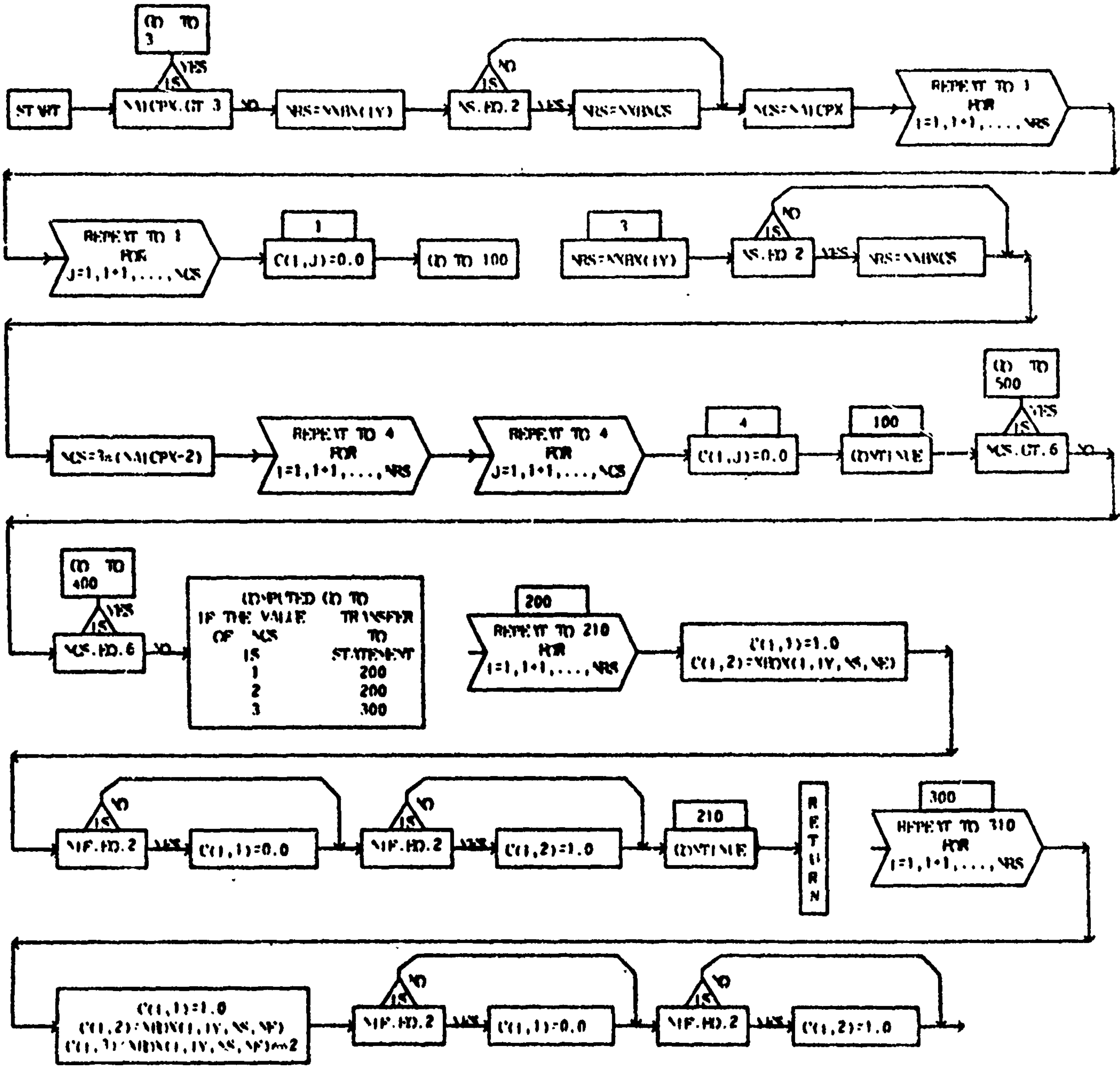

START
REPEAT TO 20
FOR
REPEAT TO 20
FOR
J=JL,JL+1,....,JR
DPHI=VPIC(K)
GO TO
10
YES
NO
K=KC(I)+MP+J-2
DPHI=DPHI+VPIC(K)
10
20
RETURN

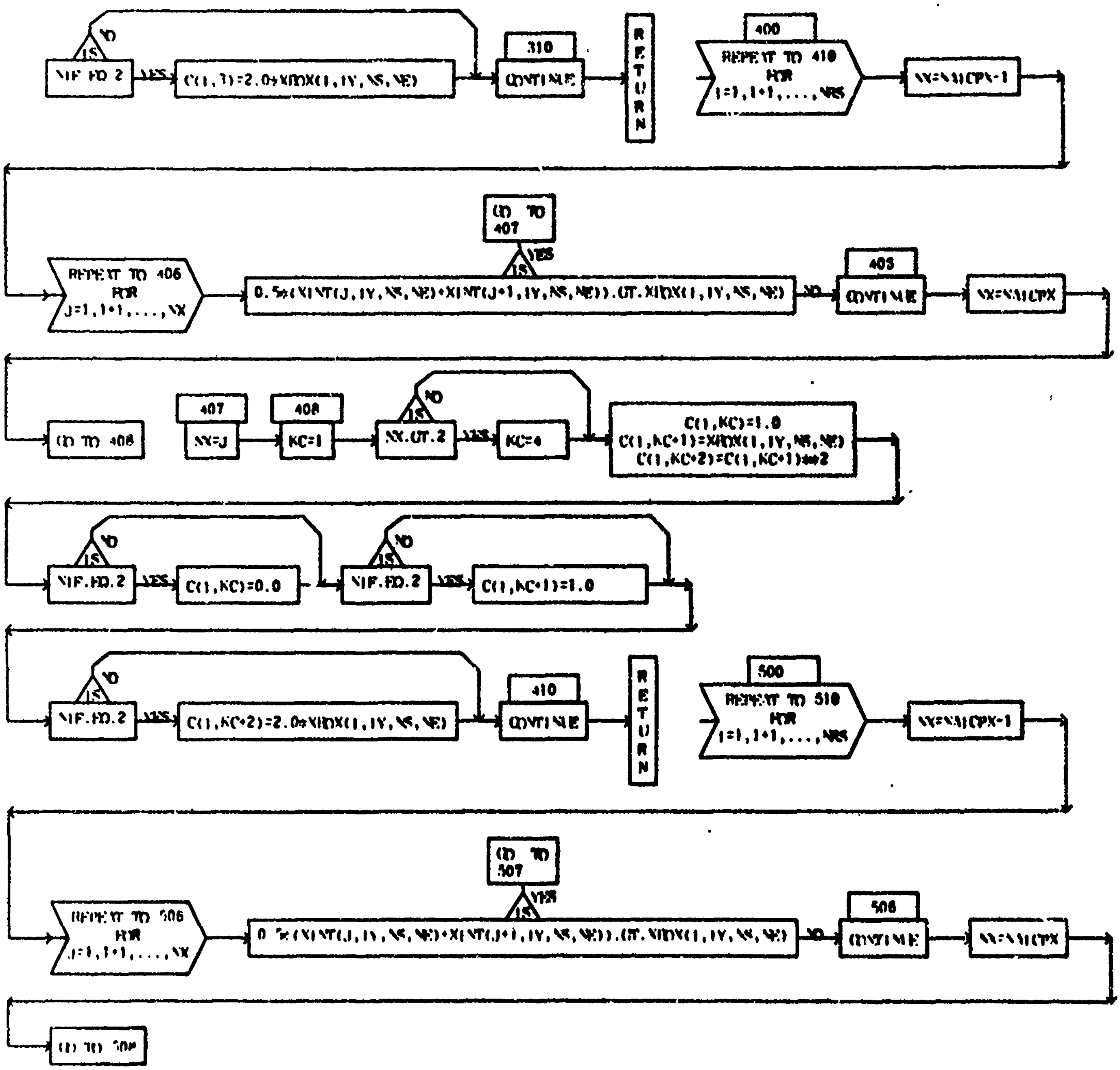


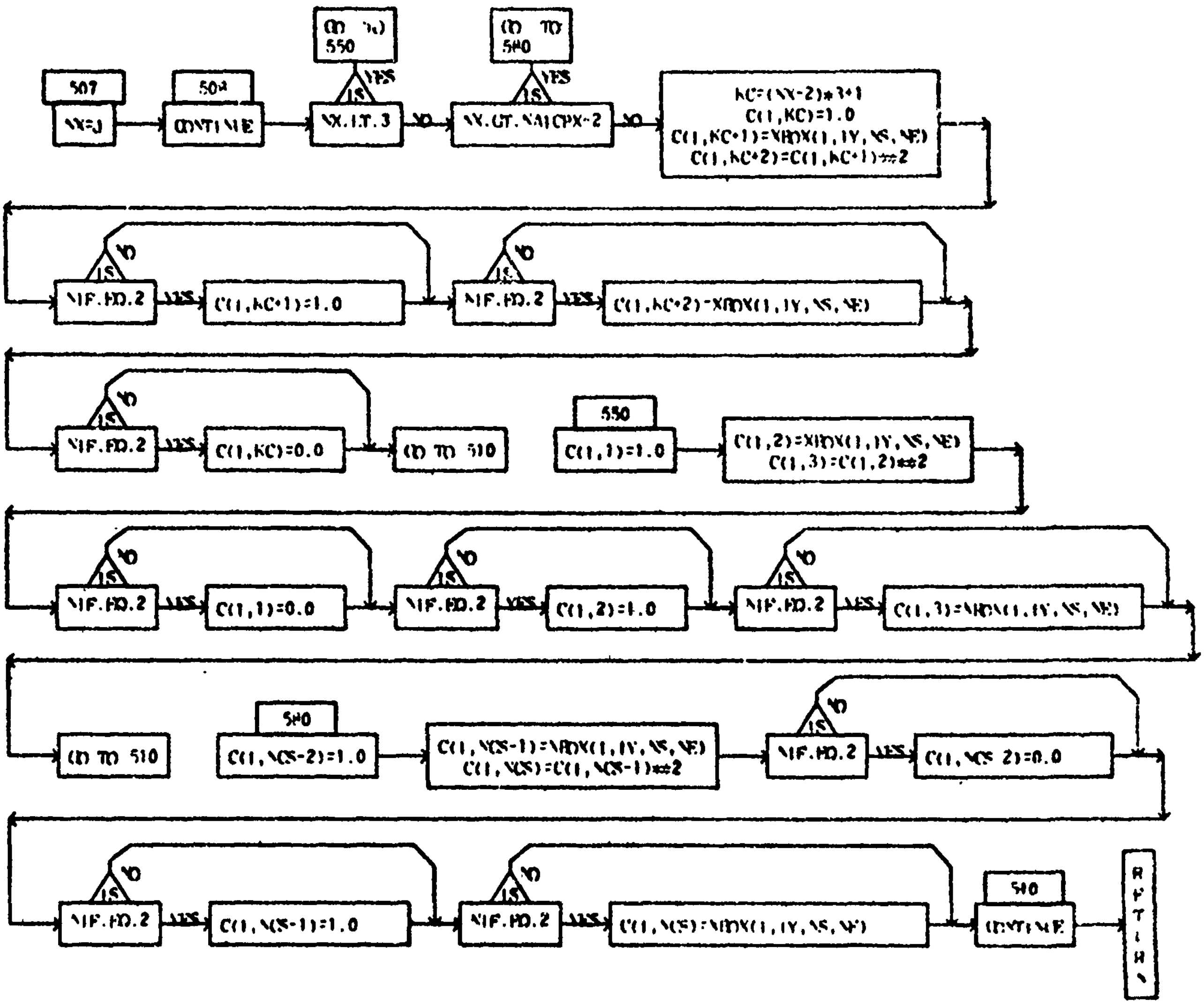
START
YES
IS
NO
10
20
RETURN
RETURN
RETURN

D I M E N S I O N E D   V A R I A B L E S

SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
C	45,45								


START
GO TO 3
YES
IS
NO
NRS=NNBX(IY)
IS
NO
NS.EQ.2
YES
NRS=NNBNCS
REPEAT TO 1
FOR
REPEAT TO 1
FOR
J=1,1+1,...,NCS
1
C(I,J)=0.0
GO TO 100
3
NRS=NNBX(IY)
NS.EQ.2
YES
REPEAT TO 4
FOR
I=1,1+1,...,NRS
REPEAT TO 4
FOR
J=1,1+1,...,NCS
4
C(I,J)=0.0
100
CONTINUE
GO TO
500
YES
IS
NCS.GT.6
NO
GO TO
400
YES
IS
NCS.EQ.6
NO
COMPUTED GO TO
IF THE VALUE TRANSFER
OF NCS TO
IS STATEMENT
1 200
2 200
3 300
200
REPEAT TO 210
FOR
I=1,1+1,...,NRS
C(I,1)=1.0
IS
NO
NIF.EQ.2
YES
C(I,1)=0.0
IS
NO
NIF.EQ.2
YES
C(I,2)=1.0
210
CONTINUE
RETURN
300
REPEAT TO 310
FOR
I=1,1+1,...,NRS
C(I,1)=1.0
IS
NO
NIF.EQ.2
YES
C(I,1)=0.0
IS
NO
NIF.EQ.2
YES
C(I,2)=1.0

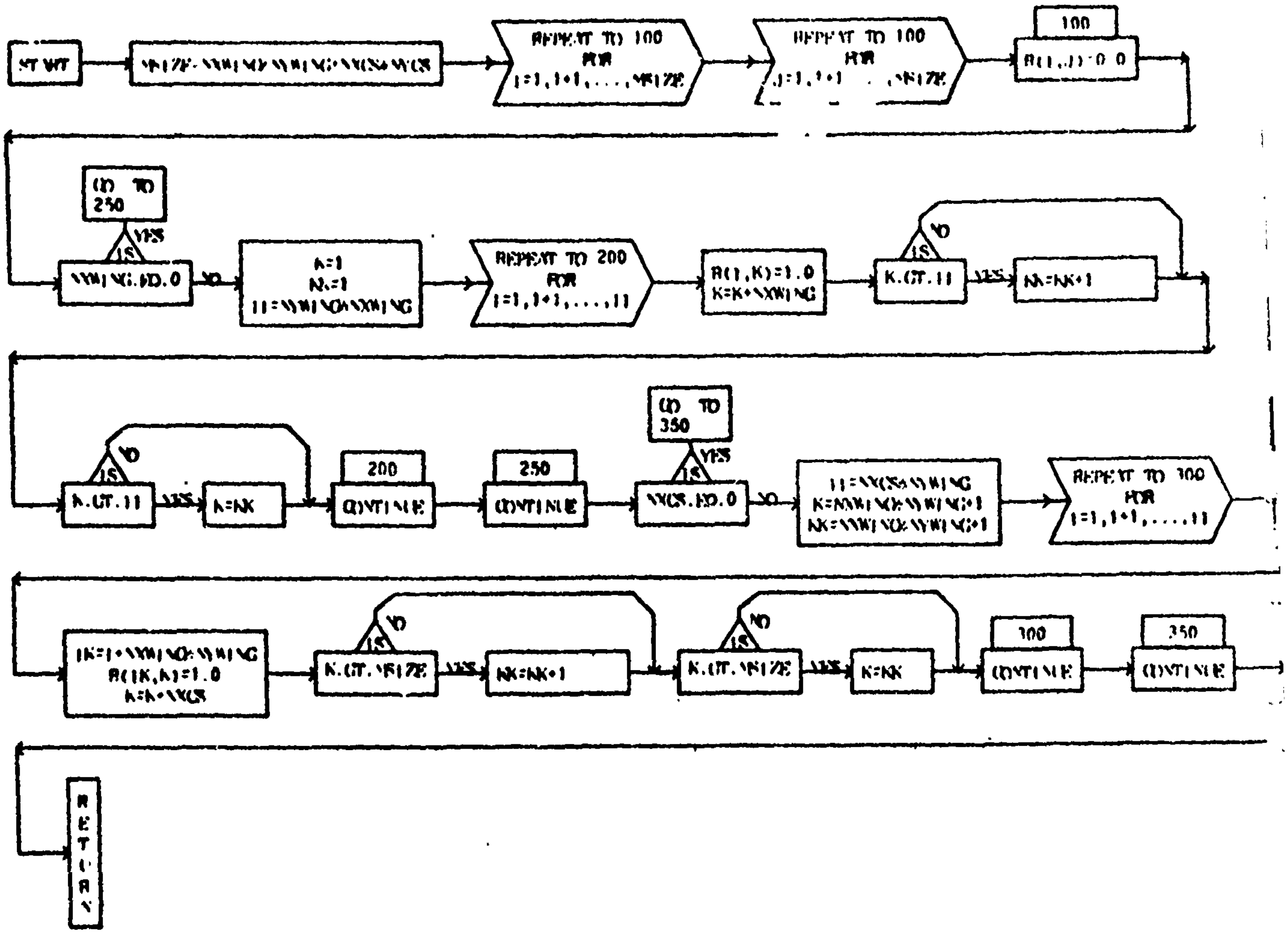

IS
NO
NIF.EQ.2
YES
C(I,3)=2.0*XIDX(I,IY,NS,NE)
310
CONTINUE
RETURN
400
REPEAT TO 410 FOR I=1,I+1,...,NRS
NX=NAICPX-1
GO TO 407
YES
REPEAT TO 406 FOR J=1,J+1,...,NX
0.5*(XINT(J,IY,NS,NE)+XINT(J+1,IY,NS,NE)).GT.XIDX(I,IY,NS,NE)
NO
405
CONTINUE
NX=NAICPX
GO TO 408
407
NX=J
408
KC=1
NX.GT.2
KC=4
C(I,KC)=1.0
C(I,KC+1)=XIDX(I,IY,NS,NE)
C(I,KC+2)=C(I,KC+1)**2
NIF.EQ.2
C(I,KC)=0.0
C(I,KC+1)=1.0
C(I,KC+2)=2.0*XIDX(I,IY,NS,NE)
410
500
REPEAT TO 510 FOR I=1,I+1,...,NRS
GO TO 507
REPEAT TO 506 FOR J=1,J+1,...,NX
506
GO TO 508

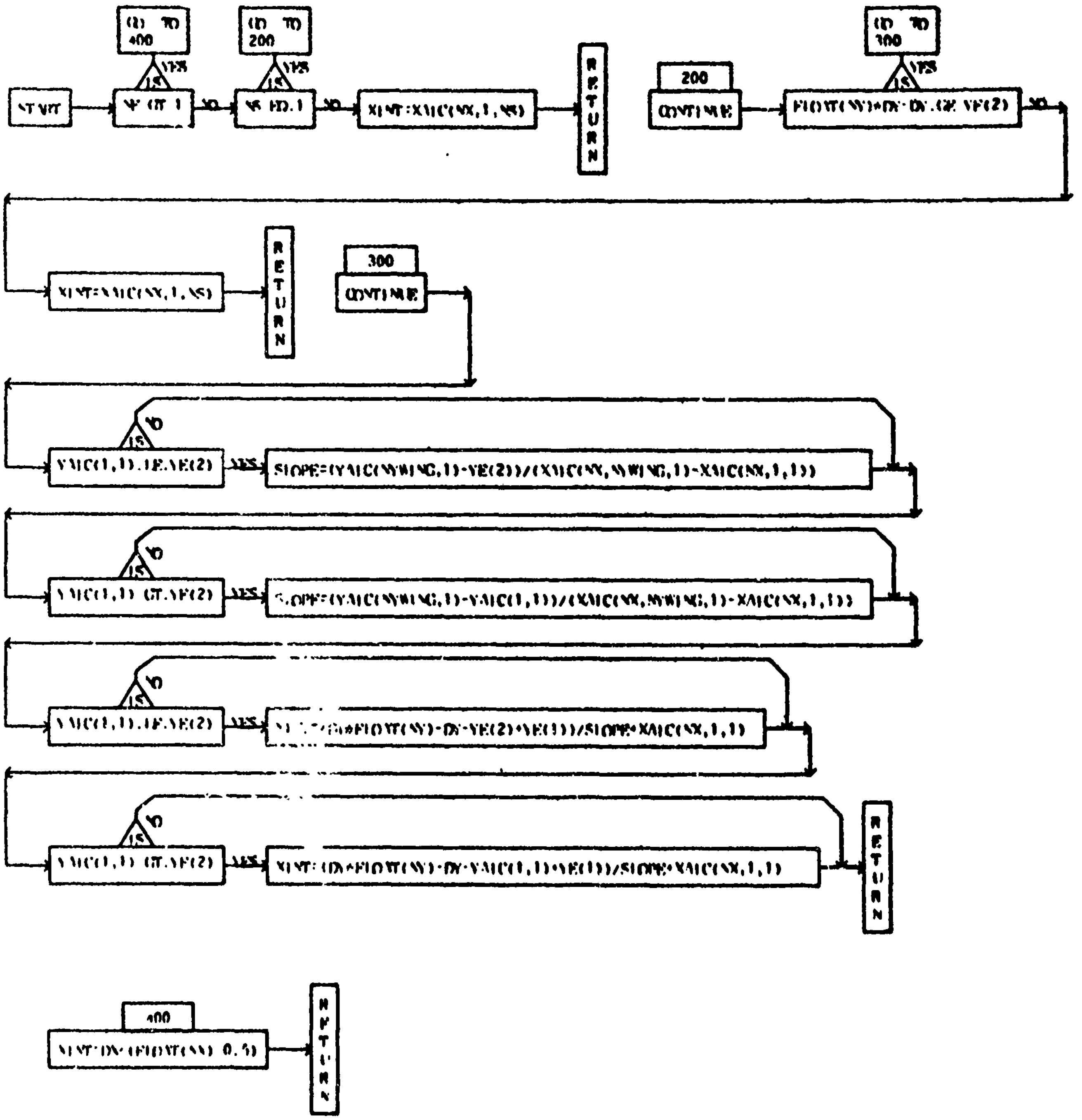


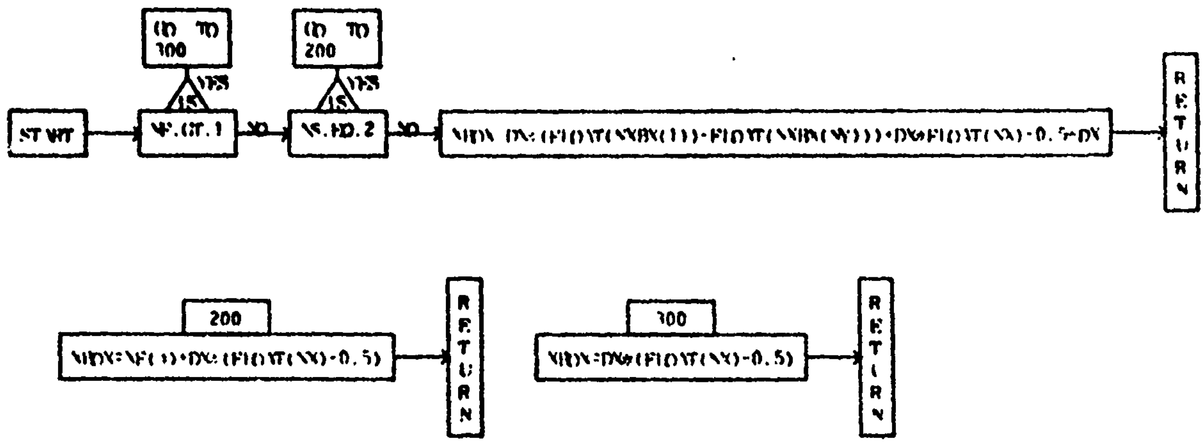
D I M E N S I O N E D   V A R I A B L E S

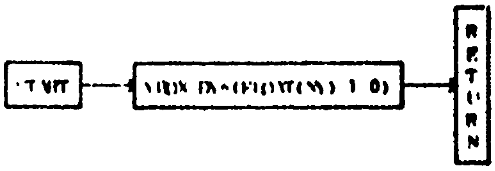
SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
R	45,45								

SUBROUTINE BMAT (NXWING,NYWING,NXCS,NYCS,MSIZE,B)



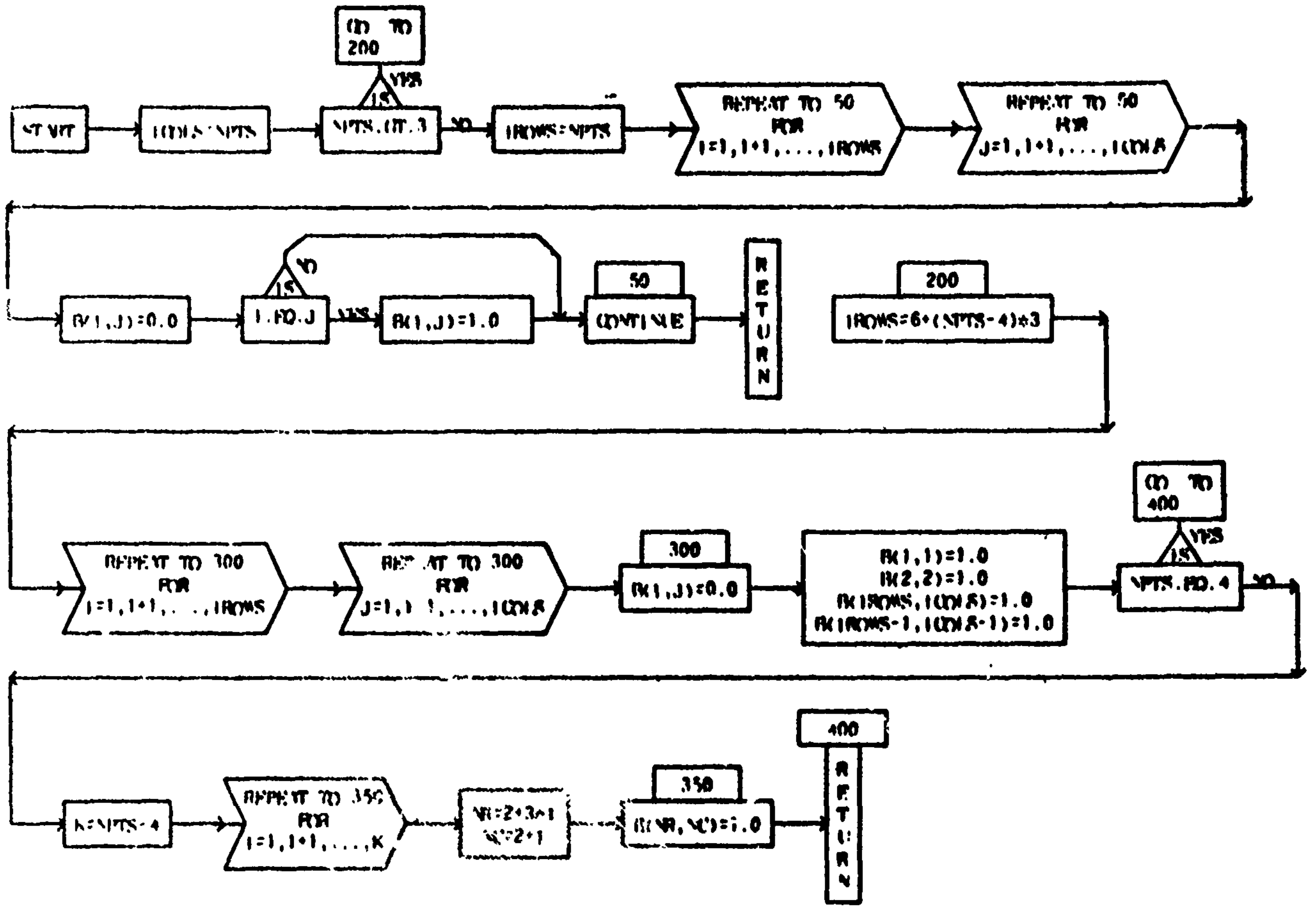

START
RETURN
200
CONTINUE
300
CONTINUE
YES
NO
IS
400
RETURN


START
GO TO 300
GO TO 200
IS
YES
NO
RETURN
200
300
RETURN
RETURN


RETURN

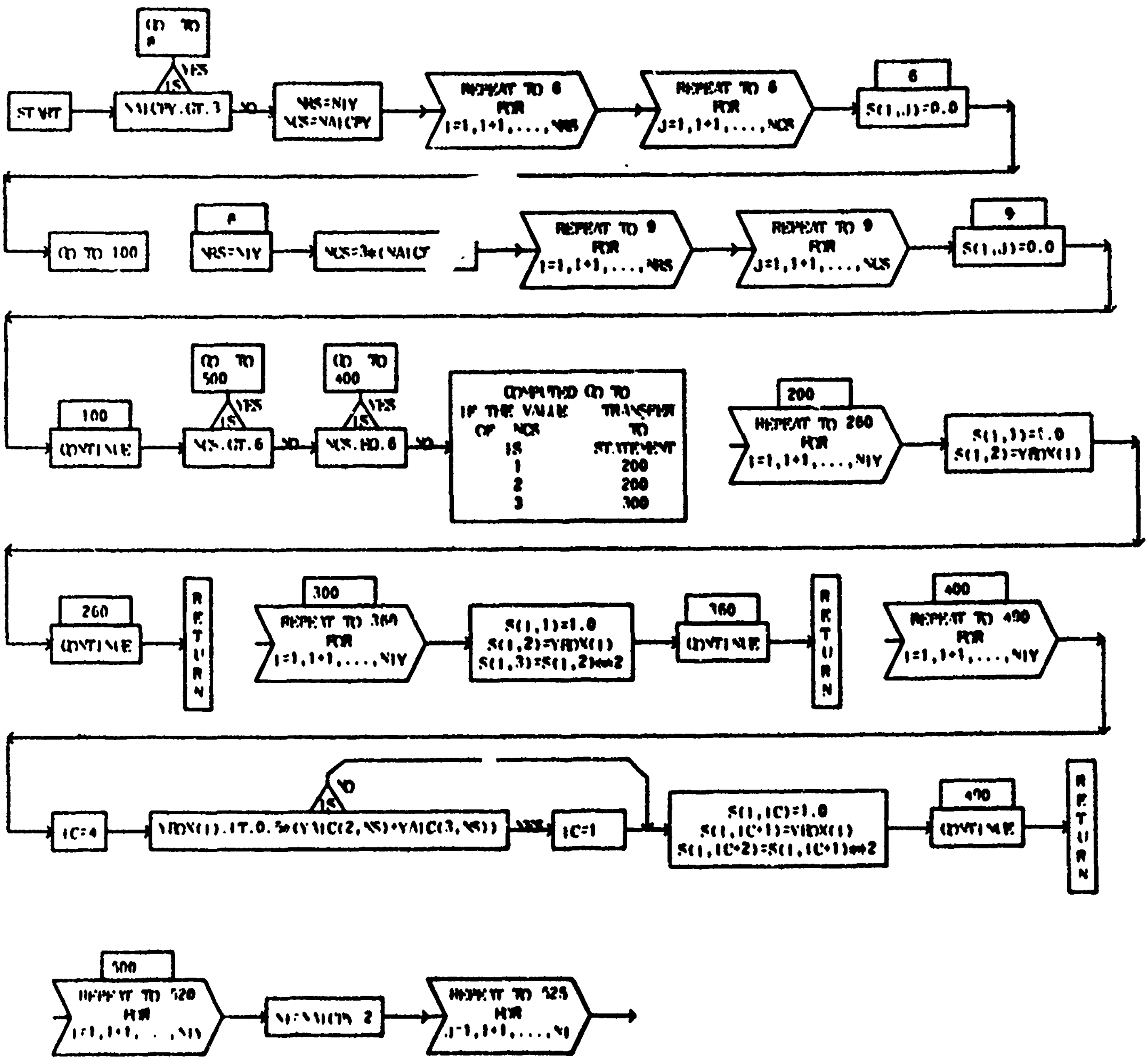
D I M E N S I O N E D   V A R I A B L E S

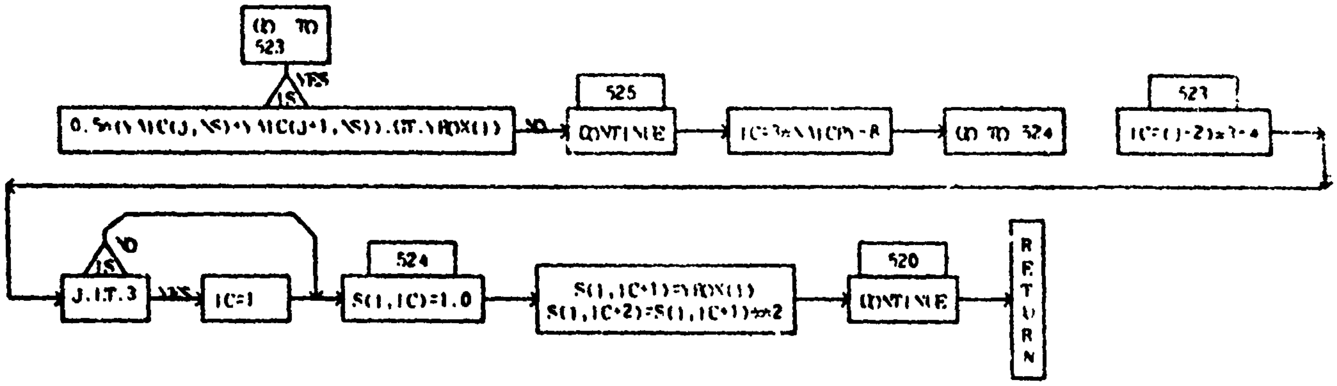
SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
B	45,45								


GO TO 200
YES
IS
START
ICOLS=NPTS
NPTS.LT.3
NO
IROWS=NPTS
REPEAT TO 50 FOR I=1,I+1,...,IROWS
REPEAT TO 50 FOR J=1,I+1,...,ICOLS
B(I,J)=0.0
NO
IS
I.EQ.J
YES
B(I,J)=1.0
50
CONTINUE
RETURN
200
IROWS=6+(NPTS-4)*3
REPEAT TO 300 FOR I=1,I+1,...,IROWS
REPEAT TO 300 FOR
300
B(I,J)=0.0
B(1,1)=1.0
B(2,2)=1.0
B(IROWS,ICOLS)=1.0
B(IROWS-1,ICOLS-1)=1.0
GO TO 400
YES
IS
NPTS.EQ.4
NO
REPEAT TO 350 FOR I=1,I+1,...,K
350
400
RETURN

DIMENSIONED VARIABLES

SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
S	45,45								

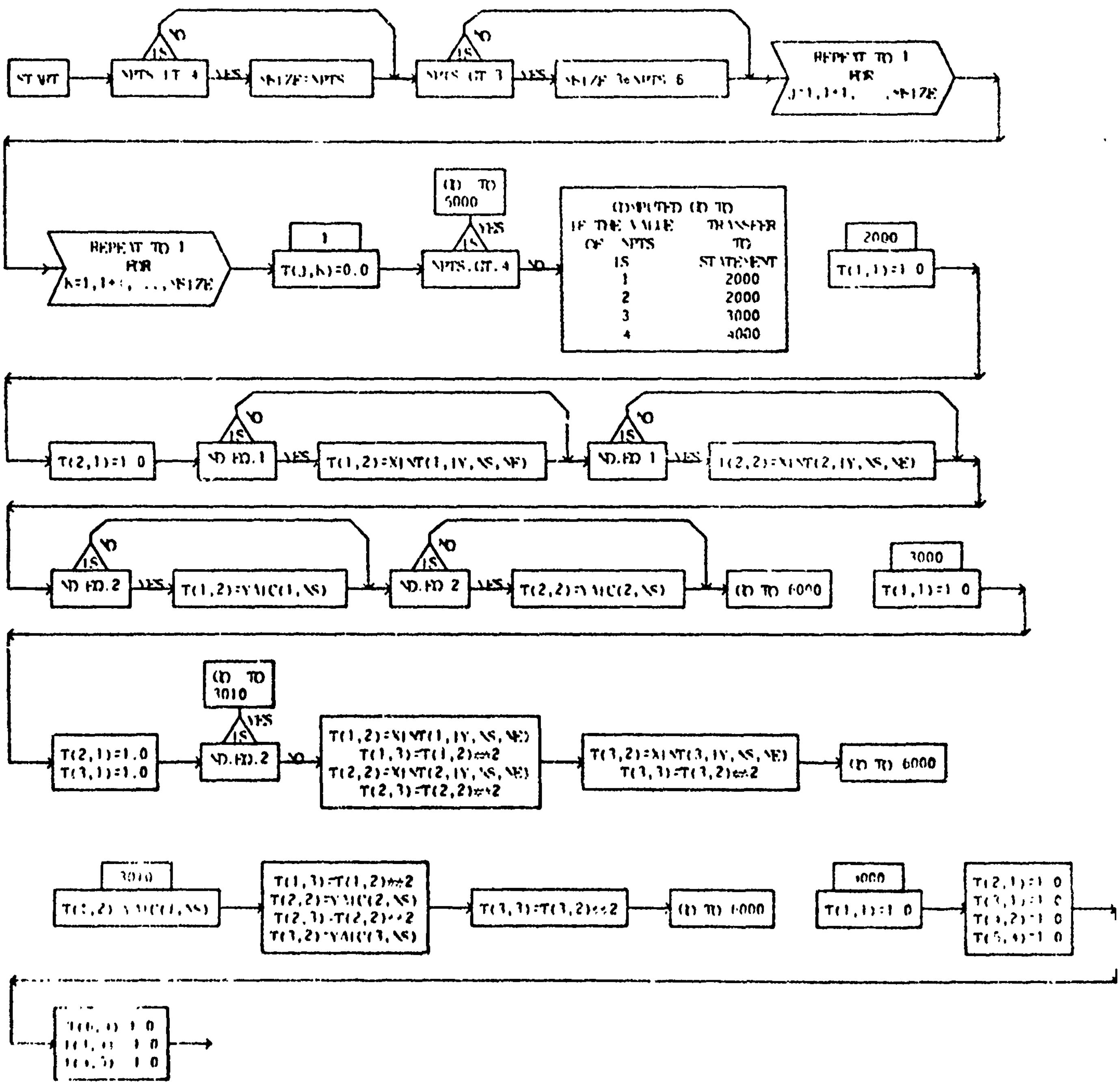


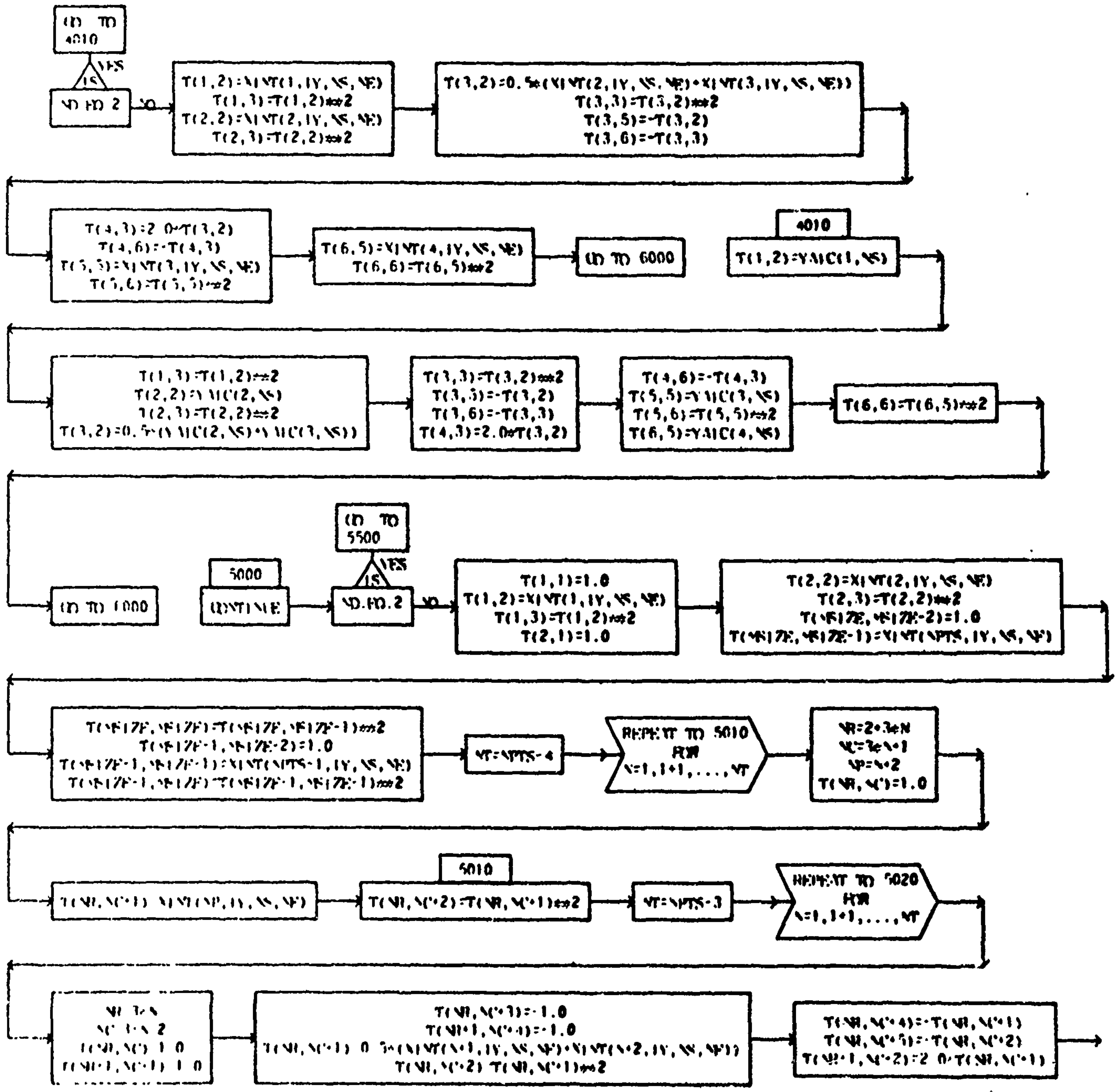

GO TO
523
YES
IS
NO
525
CONTINUE
GO TO 524
523
NO
IS
J.LT.3
YES
IC=1
524
S(I,IC)=1.0
S(I,IC+2)=S(I,IC+1)**2
520
CONTINUE
RETURN

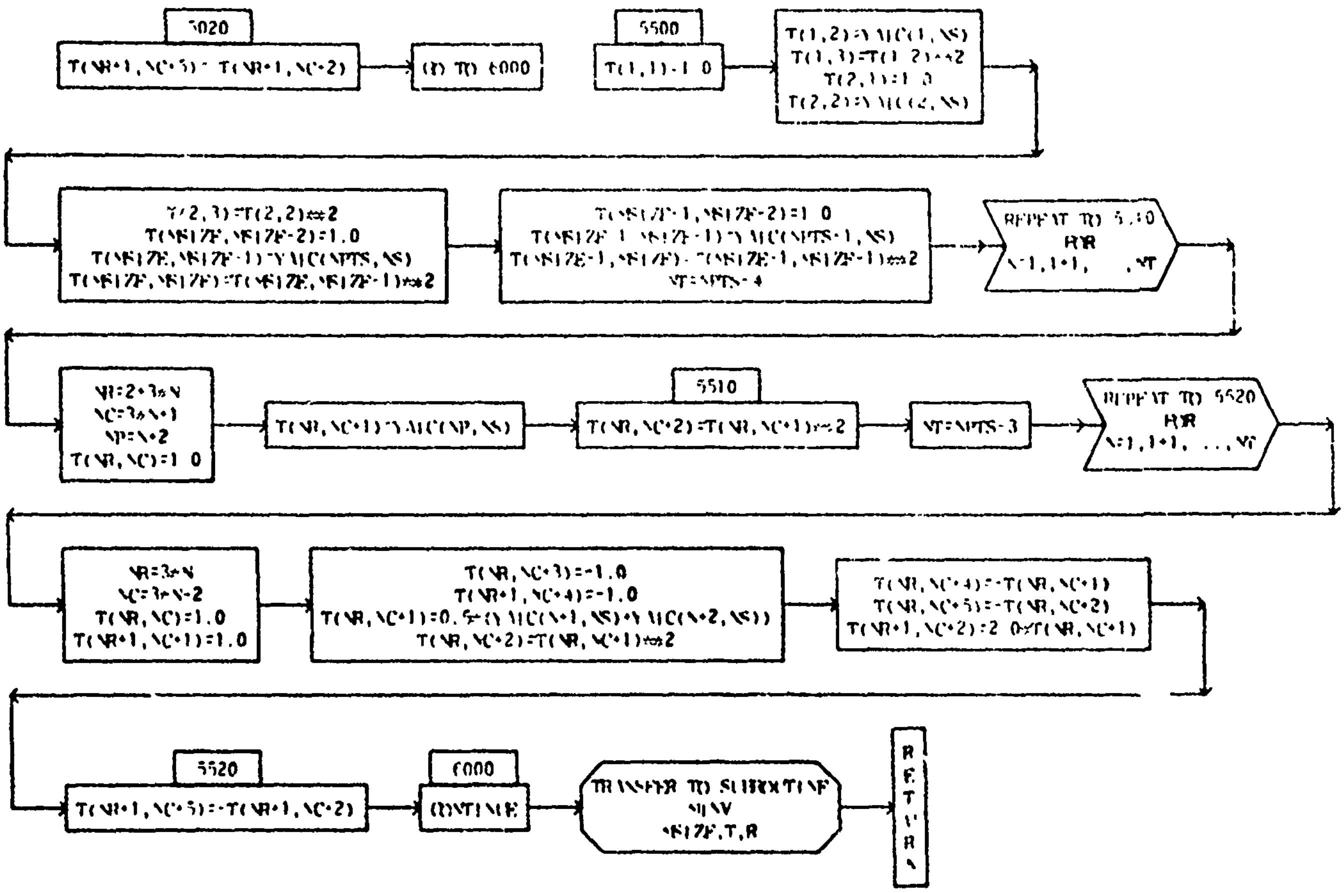
D I M E N S I O N E D   V A R I A B L E S

SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
T	45,45	R	45,45						

SUBROUTINE TNDC (NPTS,ND,NS,IY,NSIZE,NE,T,R) PAGE 1

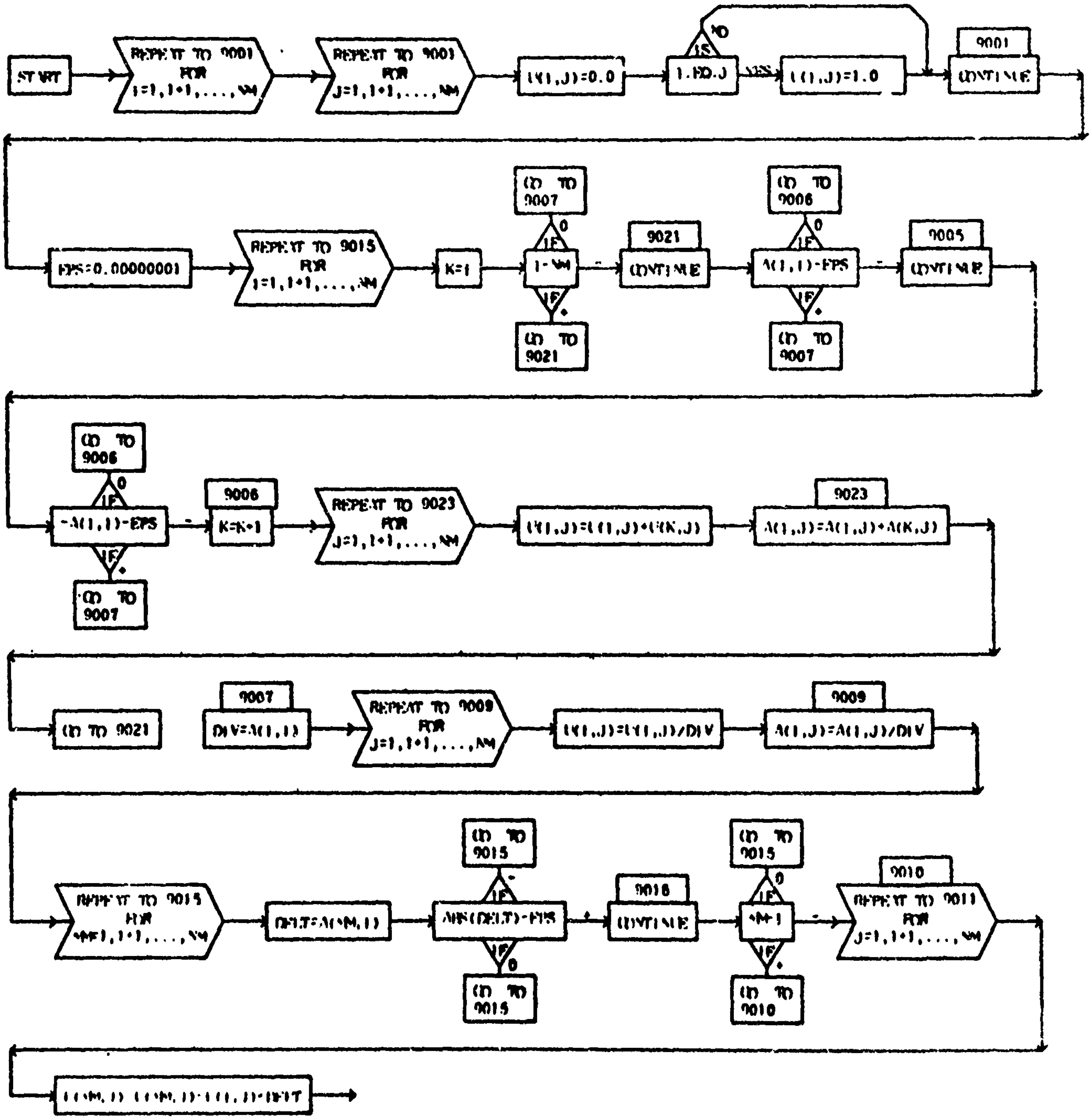


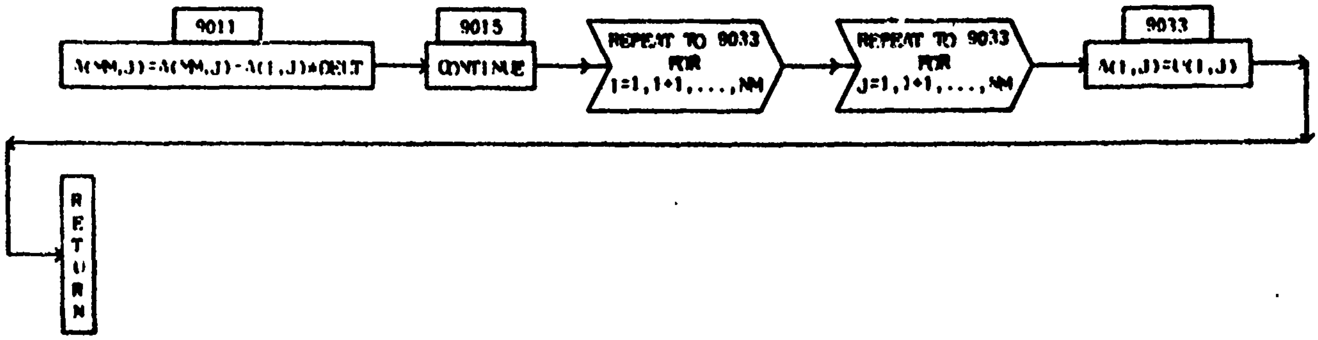

GO TO 4010
IS ND.EQ.2
YES
NO
T(1,2)=XINT(1,IY,NS,NE)
T(1,3)=T(1,2)**2
T(2,2)=XINT(2,IY,NS,NE)
T(2,3)=T(2,2)**2
T(3,2)=0.5*(XINT(2,IY,NS,NE)+XINT(3,IY,NS,NE))
T(3,3)=T(3,2)**2
T(3,5)=-T(3,2)
T(3,6)=-T(3,3)
T(4,3)=2.0*T(3,2)
T(4,6)=-T(4,3)
T(5,5)=XINT(3,IY,NS,NE)
T(5,6)=T(5,5)**2
T(6,5)=XINT(4,IY,NS,NE)
T(6,6)=T(6,5)**2
GO TO 6000
4010
T(1,2)=YALC(1,NS)
T(1,3)=T(1,2)**2
T(2,2)=YALC(2,NS)
T(2,3)=T(2,2)**2
T(3,2)=0.5*(YALC(2,NS)+YALC(3,NS))
T(3,3)=T(3,2)**2
T(3,5)=-T(3,2)
T(3,6)=-T(3,3)
T(4,3)=2.0*T(3,2)
T(4,6)=-T(4,3)
T(5,5)=YALC(3,NS)
T(5,6)=T(5,5)**2
T(6,5)=YALC(4,NS)
T(6,6)=T(6,5)**2
GO TO 1000
5000
CONTINUE
GO TO 5500
IS ND.EQ.2
YES
NO
T(1,1)=1.0
T(1,2)=XINT(1,IY,NS,NE)
T(1,3)=T(1,2)**2
T(2,1)=1.0
T(2,2)=XINT(2,IY,NS,NE)
T(2,3)=T(2,2)**2
T(MSIZE,MSIZE-2)=1.0
T(MSIZE,MSIZE-1)=XINT(NPTS,IY,NS,NE)
T(MSIZE,MSIZE)=T(MSIZE,MSIZE-1)**2
T(MSIZE-1,MSIZE-2)=1.0
T(MSIZE-1,MSIZE-1)=XINT(NPTS-1,IY,NS,NE)
T(MSIZE-1,MSIZE)=T(MSIZE-1,MSIZE-1)**2
NT=NPTS-4
REPEAT TO 5010 FOR N=1,1+1,...,NT
NR=2+3*N
NC=3*N+1
NP=N+2
T(NR,NC)=1.0
T(NR,NC+1)=XINT(NP,IY,NS,NE)
5010
T(NR,NC+2)=T(NR,NC+1)**2
NT=NPTS-3
REPEAT TO 5020 FOR N=1,1+1,...,NT
NR=3*N
NC=3*N-2
T(NR,NC)=1.0
T(NR+1,NC+1)=1.0
T(NR,NC+3)=-1.0
T(NR+1,NC+4)=-1.0
T(NR,NC+1)=0.5*(XINT(N+1,IY,NS,NE)+XINT(N+2,IY,NS,NE))
T(NR,NC+2)=T(NR,NC+1)**2
T(NR,NC+4)=-T(NR,NC+1)
T(NR,NC+5)=-T(NR,NC+2)
T(NR+1,NC+2)=2.0*T(NR,NC+1)


5020
GO TO 6000
5500
T(1,1)=1.0
T(2,1)=1.0
T(2,3)=T(2,2)**2
T(NSIZE,NSIZE-2)=1.0
NT=NPTS-4
REPEAT TO 5510
FOR
5510
NT=NPTS-3
REPEAT TO 5520
FOR
NR=3*N
NC=3*N-2
T(NR,NC)=1.0
T(NR+1,NC+1)=1.0
T(NR,NC+3)=-1.0
T(NR+1,NC+4)=-1.0
T(NR,NC+2)=T(NR,NC+1)**2
5520
6000
CONTINUE
TRANSFER TO SUBROUTINE
NSIZE,T,R
RETURN

D I M E N S I O N E D   V A R I A B L E S

SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES	SYMBOL	STORAGES
A	45,45	B	45,45						


START
REPEAT TO 9001
FOR
9001
CONTINUE
EPS=0.00000001
REPEAT TO 9015
FOR
K=I
GO TO 9007
GO TO 9021
9021
CONTINUE
GO TO 9006
GO TO 9007
9005
CONTINUE
GO TO 9006
GO TO 9007
9006
K=K+1
REPEAT TO 9023
FOR
9023
GO TO 9021
9007
DIV=A(I,I)
REPEAT TO 9009
FOR
9009
REPEAT TO 9015
FOR
DELT=A(M,I)
GO TO 9015
GO TO 9015
9018
CONTINUE
GO TO 9015
GO TO 9010
9010
REPEAT TO 9011
FOR


9011
A(NM,J)=A(NM,J)-A(I,J)*DELT
9015
CONTINUE
REPEAT TO 9033
FOR
I=1,I+1,...,NM
REPEAT TO 9033
FOR
J=1,J+1,...,NM
9033
A(I,J)=U(I,J)
RETURN

PART VII

REFERENCES

1. C. E. Watkins, D. S. Woolston, and H. J. Cunningham. "A Systematic Kernel Function Procedure for Determining Aerodynamic Forces on Oscillating or Steady Finite Wings at Subsonic Speeds." NASA TR R-48, 1959.
2. M. T. Moore and A. C. Park. "Unsteady Aerodynamics for Missile Wings and Control Surfaces." North American Aviation, Inc., Report SID 65-1254, March 1966.
3. L. V. Andrew. "Unsteady Aerodynamics for Missile Wings and Control Surfaces." North American Aviation, Inc., Report NA-67-574, 15 September 1967.
4. G. Zartarian and P. T. Hsu. "Theoretical Studies on the Prediction of Unsteady Supersonic Airloads on Elastic Wings, Parts I and II." WADC TR 56-97, 1955-56.
5. M. T. Moore and L. V. Andrew. "Unsteady Aerodynamics for Advanced Configurations, Part IV - Application of the Supersonic Mach Box Method to Intersecting Planar Lifting Surfaces." AFFDL-TDR-64-152, 1965.
6. E. R. Rodemich and L. V. Andrew. "Unsteady Aerodynamics for Advanced Configurations, Part II - A Transonic Box Method for Planar Lifting Surfaces." AFFDL-TDR-64-152, 1965.
7. P. T. Hsu. "Some Recent Developments in Flutter Analysis of Low-Aspect Ratio Wings." Proceedings of the IAS National Specialists Meeting on Dynamics and Aeroelasticity, November 6-7, 1958.
8. H. T. Vivian and L. V. Andrew. "Unsteady Aerodynamics for Advanced Configurations, Part I - Application of the Subsonic Kernel Function to Nonplanar Lifting Surfaces." AFFDL-TDR-64-152, 1965.
9. M. T. Landahl. "Kernel Function for Nonplanar Oscillating Surfaces in a Subsonic Flow". AIAA Journal, Vol. 5, No. 5, May 1967, pp. 1045-46
10. W. P. Rodden and J. D. Revell. "The Status of Unsteady Aerodynamic Influence Coefficients." S.M.F. Fund Paper No. FF-33, presented at IAS 30th Annual Meeting, New York, January 1962; preprinted as Aerospace Corp. Report TDR-930 (2230-09) TN-2, 22 November 1961.

11. W. S. Rowe. "Collocation Method for Calculating the Aerodynamic Pressure Distribution on a Lifting Surface Oscillating in Subsonic Compressible Flow." Proceedings of the AIAA Symposium on Structural Dynamics and Aeroelasticity, Boston, August 1965.

12. Z. Kopal. "Numerical Analysis" John Wiley & Sons, New York, 1955.

UNCLASSIFIED

Security Classification

DOCUMENT CONTROL DATA - R & D

(Security classification of title, body of abstract and indexing annotation must be entered when the overall report is classified)

1. ORIGINATING ACTIVITY (Corporate author) HUGHES AIRCRAFT COMPANY, MISSILE SYSTEMS DIVISION FALLBROOK AND ROSCOE BLVDS. CANOGA PARK, CALIFORNIA 91304	2a. REPORT SECURITY CLASSIFICATION UNCLASSIFIED 2b. GROUP

3. REPORT TITLE

COLLOCATION FLUTTER ANALYSIS STUDY

4. DESCRIPTIVE NOTES (Type of report and inclusive dates)

FINAL REPORT (MARCH 1968 THROUGH MARCH 1969)

5. AUTHOR(S) (First name, middle initial, last name)

DYNAMICS AND ENVIRONMENT SECTION, DONALD R. ULBRICH

6. REPORT DATE	7a. TOTAL NO. OF PAGES	7b. NO. OF REFS
APRIL 4, 1969		

8a. CONTRACT OR GRANT NO N00019-68-C-0247 b. PROJECT NO. c. d.	9a. ORIGINATOR'S REPORT NUMBER(S) 9b. OTHER REPORT NO(S) (Any other numbers that may be assigned this report)

10. DISTRIBUTION STATEMENT

IN ADDITION TO S[redacted]Y RE[redacted]MENT[redacted] WHICH A[redacted] TO TH[redacted] DOCU[redacted] AND MUS[redacted] BE MET, EACH TRANS[redacted] OF [redacted]DOCUMENT [redacted]TSIDE [redacted] AGENCIES OF [redacted] U.S. GOVERN[redacted] MUST HAVE P[redacted]R AP[redacted]ROVAL OF THE COM[redacted]ER NASC

11. SUPPLEMENTARY NOTES	12. SPONSORING MILITARY ACTIVITY NAVAL AIR SYSTEMS COMMANDS DEPARTMENT OF THE NAVY WASHINGTON, D.C.

13. ABSTRACT

THIS STUDY COVERS THE DEVELOPMENT OF A SET OF COMPUTER PROGRAM TO PERFORM FLUTTER ANALYSIS BY THE COLLOCATION METHOD. WHILE THIS METHOD HAS BEEN KNOWN FOR SOME TIME, ONLY RECENTLY HAVE ADVANCES IN COMPUTER TECHNOLOGY MADE THE METHOD TECHNICALLY AND FINANCIALLY FEASIBLE. THE INGREDIENTS OF A COLLOCATION FLUTTER ANALYSIS ARE 1) A FLEXIBILITY MATRIX, 2) AERODYNAMIC INFLUENCE COEFFICIENT MATRIX, AND 3) AN EIGENVALUE SOLUTION. THIS STUDY IS PRESENTED IN FOUR VOLUMES. VOLUME I CONTAINS A GENERAL PROGRAM DISCUSSION. VOLUME II CONTAINS THE PROGRAM FLUENC WHICH CALCULATES THE FLEXIBILITY MATRIX. VOLUME III CONTAINS A SET OF THREE PROGRAMS TO CALCULATE AERODYNAMIC INFLUENCE COEFFICIENTS FOR SUBSONIC, TRANSONIC, AND SUPERSONIC FLIGHT REGIMES. VOLUME IV CONTAINS THE PROGRAM COFA WHICH SETS UP AND SOLVES THE FLUTTER EIGENVALUE MATRIX.

DD FORM 1 NOV 65 1473

UNCLASSIFIED

Security Classification

14 KEY WORDS	LINK A		LINK B		LINK C	
	ROLE	WT	ROLE	WT	ROLE	WT
FLUTTER						
VIBRATION						
AERODYNAMIC INFLUENCE COEFFICIENTS						